CHAPTER

7

Strategy and Technology

OPENING CASE

Format War—Blu-Ray Versus HD-DVD

A format war is developing in the consumer electronics industry between two different versions of next-generation high-definition DVD players and discs. In one camp is Sony with its Blu-ray format; in the other is Toshiba, which is championing the rival HD-DVD format. Both high-definition formats offer a dramatic improvement in picture and sound quality over established DVD technology and are designed to work with high-definition televisions. Although each new format will play old DVDs, the two standards are incompatible with each other. Blu-ray players will not accept DVDs formatted for HD-DVD, and vice versa.

Format wars like this have occurred many times in the past. VHS versus Betamax in the videocassette market and Windows versus Macintosh in personal computer operating systems are classic examples. If history is any guide, format wars tend to be "winner-takes-all" contests, with the loser being vanquished to a niche (as in the case of Apple's Macintosh operating system), or exiting the market altogether (as in the case of Sony's Betamax format). Format wars are a high-stakes game.

Both Sony and Toshiba have been working hard to ensure that their format gains an early lead in sales. In turn, so the thinking goes, this will increase the supply of preformatted discs designed to play on one format or the other, which should lead to a further increase in sales of the format that has the largest share of the market, and thus to its eventual dominance. A key strategy of both companies has been to line up film studios and get them to commit to issuing films based on their format.

Initially it looked as if Sony had the early advantage. Prior to the technology being launched in the market, Columbia Pictures and MGM (both owned by Sony), along with Disney and Fox Studios, all committed exclusively to Blu-ray. By late 2005, several other studios that had initially committed exclusively to HD-DVD, including Warner Brothers and Paramount, also indicated that they would support Blu-ray as well. Warner and Paramount cited Blu-ray's momentum among other studios and its strong copyright protection mechanisms. This left just Universal Studios committed exclusively to HD-DVD.

To further strengthen its hand, Sony announced that it would incorporate Blu-ray technology in its next-generation P3 videogame console and its Vaio line of personal computers. Hewlett-Packard and Dell Computer also indicated that they would support the Blu-ray format. Sony even licensed the Blu-ray format to several other consumer electronics firms, including Samsung, in a bid to increase the supply of Blu-ray players in stores.

Then things began to go wrong for Sony. The company had to delay delivery of its P3 videogame console by a year due to engineering problems, which sapped some of the momentum from Blu-ray. Microsoft took advantage of this misstep, announcing that it would market an HD-DVD player that would work with its own videogame console, Xbox 360. In mid-2006, the first Blu-ray and HD-DVD players hit the market—the Blu-ray players were more expensive, as much as twice the price of entry-level HD-DVD players. According to Toshiba, HD-DVD players and discs are cheaper to manufacture, although Sony disputes this. To complicate matters, one of the first Blu-ray players, made by Sony licensee Samsung, was shipped with a bad chip that marred its image quality.

By late 2006, some firms were beginning to hedge their bets. Hewlett-Packard reversed its earlier position and said that it would support both standards. So who will win this war? At this stage, it is too early to say. One possibility, however, is that neither format will win. Faced with two incompatible formats, consumers may do what they have in the past: wait. And without consumer dollars to drive adoption of one format over the other, the market may fail to gain traction.[1]

OVERVIEW

The format war now unfolding in the consumer electronics industry between two competing and incompatible versions of next-generation high-definition DVDs is typical of the nature of competition in high-technology industries (see the Opening Case). In this chapter, we will take a close look at the nature of competition and strategy in high-technology industries. **Technology** refers to the body of scientific knowledge used in the production of goods or services. **High-technology (high-tech) industries** are those in which the underlying scientific knowledge that companies in the industry use is advancing rapidly, and by implication, so are the attributes of the products and services that result from its application. The computer industry is often thought of as the quintessential example of a high-technology industry. Other industries often considered high-tech are telecommunications, where new technologies based on wireless and the Internet have proliferated in recent years; consumer electronics, where the digital technology underlying products from high-definition DVD players to videogame terminals and digital cameras is advancing rapidly; pharmaceuticals, where new technologies based on cell biology, recombinant DNA, and genomics are revolutionizing the process of drug discovery; power generation, where new technologies based on fuel cells and cogeneration may change the economics of the industry; and aerospace, where the combination of new composite materials, electronics, and more efficient jet engines are giving birth to a new era of superefficient commercial jet aircraft such as Boeing's 787.

This chapter focuses on high-technology industries for a number of reasons. First, technology is accounting for an ever larger share of economic activity. Estimates suggest that 12 to 15% of total economic activity in the United States is accounted for by information technology industries.[2] This figure actually underestimates the true impact of technology on the economy because it ignores the other high-technology areas we just mentioned. Moreover, as technology advances, many low-technology industries are becoming more high-tech. For example, the development of biotechnology and genetic engineering transformed the production of seed corn, long considered a low-technology business, into a high-technology business. Retailing used to be considered a low-technology business, but the shift to online retailing, led by companies like Amazon, has changed this. Moreover, high-technology products are making their way into a wide range of businesses; today a Ford Explorer contains more computing power than the multimillion-dollar mainframe computers used in the Apollo space program, and the competitive advantage of physical stores, such as Wal-Mart, is based on their use of information technology. The circle of high-technology industries is both large and expanding, and even in industries not thought of as high-tech, technology is revolutionizing aspects of the product or production system.

Although high-tech industries may produce very different products, when it comes to developing a business model and strategies that will lead to a competitive advantage and superior profitability and profit growth, they often face a similar situation. For example, winner-take-all format wars are common in many high-technology industries, such as the consumer electronics and computer industries (see the Opening Case for an example of an ongoing format war). This chapter examines the competitive features found in many high-tech industries and the kinds of strategies that companies must adopt to build business models that will allow them to achieve superior profitability and profit growth.

When you have completed this chapter, you will have an understanding of the nature of competition in high-tech industries and the strategies that companies can pursue to succeed in those industries.

Technical Standards and Format Wars

Especially in high-tech industries, ownership of **technical standards**—a set of technical specifications that producers adhere to when making the product or a component of it—can be an important source of competitive advantage.[3] Indeed, in many cases, the source of product differentiation is based on the technical standard. As in the high-definition DVD market, often only one standard will come to dominate a market, so many battles in high-tech industries revolve around companies competing to be the one that sets the standard.

Battles to set and control technical standards in a market are referred to as **format wars**; they are essentially battles to control the source of differentiation and thus the value that such differentiation can create for the customer. Because differentiated products often command premium prices and are often expensive to develop, the competitive stakes are enormous. The profitability and very survival of a company may depend on the outcome of the battle. For example, the outcome of the battle now being waged over the establishment and ownership of the standard for high-definition DVDs will help determine which companies will be leaders for the next decade in that marketplace (see the Opening Case).

Examples of Standards

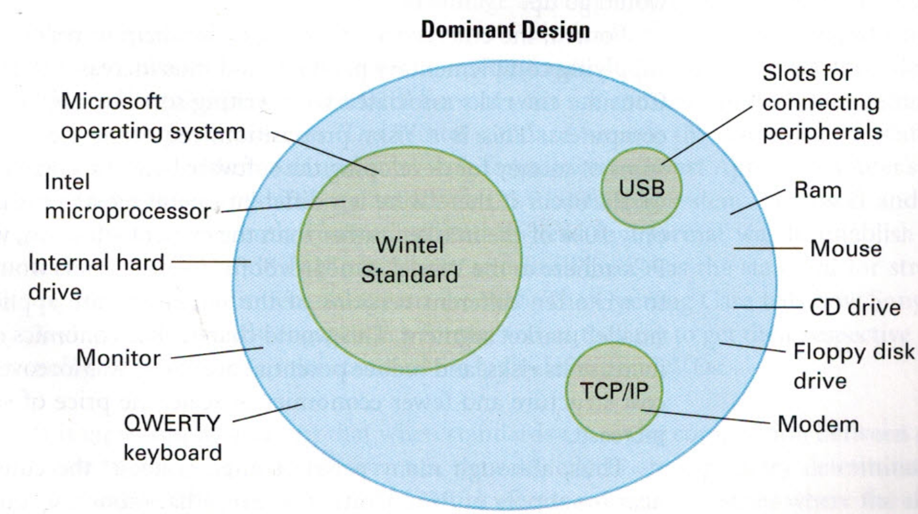
A familiar example of a standard is the layout of a computer keyboard. No matter what keyboard you buy, the letters are all in the same pattern.[4] The reason is quite obvious. Imagine if each computer maker changed the ways the keys were laid out—if some started with QWERTY on the top row of letters (which is indeed the format used and is known as the QWERTY format), some with YUHGFD, and some with ACFRDS. If you learned to type on one layout, it would be irritating and time-consuming to have to relearn on a YUHGFD layout. The standard format (QWERTY) makes it easy for people to move from computer to computer because the input medium, the keyboard, is set out in a standard way.

Another example of a technical standard concerns the dimensions of containers used to ship goods on trucks, railcars, and ships: all have the same basic dimensions—the same height, length, and width—and all make use of the same locking mechanisms to hold them onto a surface or to bolt against each other. Having a standard ensures that containers can be moved easily from one mode of transportation to another—from trucks to railcars, to ships, and back to railcars. If containers lacked standard dimensions and locking mechanisms, it would suddenly become much more difficult to ship containers around the world. Shippers would have to make sure that they had the right kind of container to go on the ships, trucks, and railcars scheduled to carry a particular container around the world—very complicated indeed.

Consider, finally, the personal computer. Most share a common set of features: an Intel or Intel-compatible microprocessor, random access memory (RAM), a Microsoft operating system, an internal hard drive, a floppy disk drive, a CD drive, a keyboard, a monitor, a mouse, a modem, and so on. We call this set of features the dominant design for personal computers (a **dominant design** refers to a common set of features or design characteristics). Embedded in this design are several technical standards (see Figure 7.1). For example, the Wintel technical standard is based on an Intel microprocessor and a Microsoft operating system. Microsoft and Intel "own" that standard, which is central to the personal computer. Developers of software applications, component parts, and peripherals such as printers adhere to this standard when developing their own products because this guarantees that their products will work well with a personal computer based on the Wintel standard. Another technical standard for connecting peripherals to the PC is the Universal Serial Bus (USB), established by an industry standards-setting board. No one owns it; the standard is in the public domain. A third technical standard is for communication between a PC and the Internet via a modem. Known as TCP/IP, this standard was also set by an industry association and is in the public domain. Thus, as with many other products, the PC is actually based on several technical standards. It is also important to note that when a company owns a standard, as Microsoft and Intel do with the Wintel standard, it may be a source of competitive advantage and high profitability.

FIGURE 7.1

Technical Standards for Personal Computers



Benefits of Standards

Standards emerge because there are economic benefits associated with them. First, having a technical standard helps to guarantee compatibility between products and their complements—other products used with them. For example, containers are used with railcars, trucks, and ships, and PCs are used with software applications. Compatibility has the tangible economic benefit of reducing the costs associated with making sure that products work well with each other.

Second, having a standard can help to reduce confusion in the minds of consumers. A few years ago, several consumer electronics companies were vying with each other to produce and market the first generation of DVD players, and they were championing different variants of the basic DVD technology—different standards—that were incompatible with each other; a DVD disk designed to run on a DVD player made by Toshiba would not run on a player made by Sony, and vice versa. The companies feared that selling these incompatible versions of the same technology would produce confusion in the minds of consumers, who would not know which version to purchase and might decide to wait and see which technology ultimately dominated the marketplace. With lack of demand, the technology might fail to gain traction in the marketplace and would not be successful. To avoid this possibility, the developers of DVD equipment established a standard-setting body for the industry, the DVD Forum, which established a common technical standard for DVD players and disks that all companies adhered to. The result was that when DVDs were introduced, they adhered to a common standard, which avoided confusion in consumers' minds. This helped to boost demand for DVD players, making them one of the fastest-selling technologies of the late 1990s and early 2000s. However, the DVD Forum has not been able to agree on a common standard for high-definition DVDs (see the Opening Case).

Third, the emergence of a standard can help to reduce production costs. Once a standard emerges, products based on that standard design can be mass-produced, enabling the manufacturers to realize substantial economies of scale and lower their cost structures. The fact that there is a central standard for PCs (the Wintel standard) means that the component parts for a PC can be mass-produced. A manufacturer of internal hard drives, for example, can mass-produce drives for Wintel PCs and thus can realize substantial scale economies. If there were several competing and incompatible standards, each of which required a unique type of hard drive, production runs for hard drives would be shorter, unit costs would be higher, and the cost of PCs would go up.

Fourth, the emergence of standards can help to reduce the risks associated with supplying complementary products and thus increase the supply for those products. Consider the risks associated with writing software applications to run on personal computers. This is a risky proposition, requiring the investment of considerable sums of money for developing the software before a single unit is sold. Imagine what would occur if there were ten different operating systems in use for PCs, each with only 10% of the market, rather than the current situation, where 95% of the world's PCs adhere to the Wintel standard. Software developers would be faced with the need to write ten different versions of the same software application, each for a much smaller market segment. This would change the economics of software development, increase its risks, and reduce potential profitability. Moreover, because of their higher cost structure and fewer economies of scale, the price of software programs would increase.

Thus, although many people complain about the consequences of Microsoft's near monopoly of PC operating systems, that monopoly does have at least one good effect: it substantially reduces the risks facing the makers of complementary products and the costs of those products. In fact, standards lead to both low-cost and differentiation advantages for individual companies and can help raise the level of industry profitability.

Establishment of Standards

Standards emerge in an industry in three main ways. First, recognizing the benefits of establishing a standard, companies in an industry might lobby the government to mandate an industry standard. In the United States, for example, the Federal Communications Commission (FCC), after detailed discussions with broadcasters and consumer electronics companies, has mandated a single technical standard for digital television broadcasts (DTV) and required broadcasters to have capabilities in place for broadcasting digital signals based on this standard by 2006. The FCC took this step because it believed that without government action to set the standard, the rollout of DTV would be very slow. With a standard set by the government, consumer electronics companies can have greater confidence that a market will emerge, and this should encourage them to develop DTV products.

Second, technical standards are often set by cooperation among businesses, without government help, often through the medium of an industry forum, such as the DVD Forum. Companies cooperate in this way when they decide that competition among them to create a standard might be harmful because of the uncertainty that it would create in the minds of consumers.

When standards are set by the government or an industry association, they fall into the **public domain**, meaning that any company can freely incorporate into its products the knowledge and technology on which the standard is based. For example, no one owns the QWERTY format, and therefore no one company can profit from it directly. Similarly, the language that underlies the presentation of text and graphics on the Web, hypertext markup language (HTML), is in the public domain; it is free for all to use. The same is true for TCP/IP, the communications standard used for transmitting data on the Internet.

Often, however, the industry standard is selected competitively by the purchasing patterns of customers in the marketplace—that is, by market demand. In this case, the strategy and business model a company has developed for promoting its technological standard are of critical importance because ownership of an industry standard that is protected from imitation by patents and copyrights is a valuable asset—a source of sustained competitive advantage and superior profitability. Microsoft and Intel, for example, both owe their competitive advantage to format wars, which exist between two or more companies competing against each other to get their designs adopted as the industry standard. Format wars are common in high-tech industries because of the high stakes. The Wintel standard became the dominant standard for PCs only after Microsoft and Intel won format wars against Apple Computer's proprietary system and later against IBM's OS/2 operating system. Microsoft and Real Networks are currently competing head-to-head in a format war to establish rival technologies—Windows Media Player and RealPlayer—as the standard for streaming video and audio technology on the Web. The Opening Case tells how Sony and Toshiba are currently engaged in a format war as they try to get their respective technologies established as the standard for high-definition DVDs.

Network Effects, Positive Feedback, and Lockout

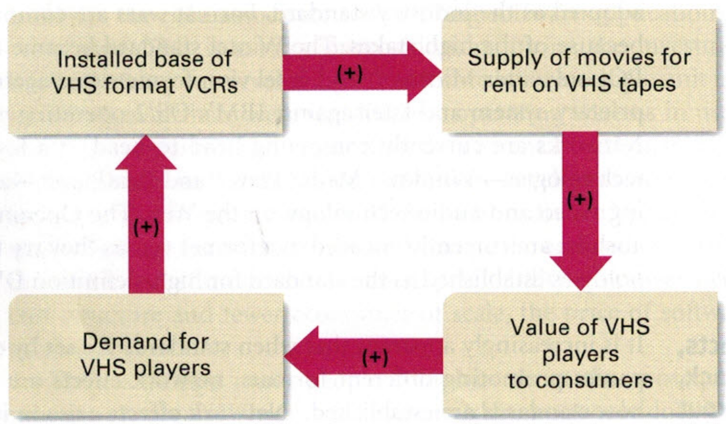
It is increasingly apparent that when standards are set by competition between companies promoting different formats, network effects are a primary determinant of how standards are established.[5] **Network effects** arise in industries where the size of the network of complementary products is a primary determinant of demand for an industry's product. For example, the demand for automobiles early in the twentieth century was an increasing function of the network of paved roads and gas stations. Similarly, the demand for telephones is an increasing function of the number of other numbers that can be called with that phone, that is, of the size of the telephone network (the telephone network is the complementary product). When the first telephone service was introduced in New York City, only a hundred numbers could be called. The network was very small because of the limited number of wires and telephone switches, which made the telephone a relatively useless piece of equipment. As more and more people got telephones and as the network of wires and switches expanded, the value of a telephone connection increased. This led to an increase in demand for telephone lines, which further increased the value of owning a telephone, setting up a positive feedback loop.

To understand why network effects are important in the establishment of standards, consider the classic example of a format war: the battle between Sony and Matsushita to establish their respective technology for videocassette recorders (VCRs) as the standard in the marketplace. Sony was first to market with its Betamax technology, followed by Matsushita with its VHS technology. Both companies sold VCR recorder-players, and movie studios issued films prerecorded on VCR tapes for rental to consumers. Initially, all tapes were issued in Betamax format to play on Sony's machine. Sony did not license its Betamax technology, preferring to make all of the player-recorders itself. When Matsushita entered the market, it realized that it would have to encourage movie studios to issue movies for rental on VHS tapes to make its VHS format players valuable to consumers. The only way to do that, Matsushita's managers reasoned, was to increase the installed base of VHS players as rapidly as possible. They believed that the greater the installed base of VHS players, the greater the incentive would be for movie studios to issue movies for rental on VHS format tapes. The more prerecorded VHS tapes available for rental, the greater the value of a VHS player to consumers, and therefore, the greater the demand would be for VHS players (see Figure 7.2). Matsushita wanted to exploit a positive feedback loop.

To do this, Matsushita chose a licensing strategy under which any consumer electronics company was allowed to manufacture VHS format players under license. The strategy worked. A large number of companies agreed to manufacture VHS players,

FIGURE 7.2

Positive Feedback in the Market for VCRs



and soon far more VHS players were available for purchase in stores than Betamax players. As sales of VHS players started to grow, movie studios issued more films for rental in VHS format, and this stoked demand. Before long, it was clear to anyone who walked into a video rental store that there were more and more VHS tapes available for rent and fewer and fewer Betamax tapes. This served to reinforce the positive feedback loop, and ultimately Sony's Betamax technology was shut out of the market. The pivotal difference between the two companies was strategy: Matsushita chose a licensing strategy, and Sony did not. As a result, Matsushita's VHS technology became the de facto standard for VCRs, while Sony's Betamax technology was locked out.

The general principle that emerges from this example is that when two or more companies are competing with each other to get their technology adopted as a standard in an industry, and when network effects and positive feedback loops are important, the company that wins the format war will be the one whose strategy best exploits positive feedback loops. It turns out that this is a very important strategic principle in many high-technology industries, particularly computer hardware, software, telecommunications, and consumer electronics. Microsoft is where it is today because it exploited a positive feedback loop. So did Dolby (see Strategy in Action 7.1).

An important implication of the positive feedback process is that as the market settles on a standard, companies promoting alternative standards can become locked out of the market when consumers are unwilling to bear the switching costs required for them to abandon the established standard and adopt the new standard. In this context, switching costs are the costs that consumers must bear to switch from a product based on one technological standard to a product based on another.

To illustrate, imagine that a company developed an operating system for personal computers that was both faster and more stable (crashed less) than the current standard in the marketplace, Microsoft Windows. Would this company be able to gain significant market share from Microsoft? Only with great difficulty. Consumers buy personal computers not for their operating system but for the applications that run on that system. A new operating system would initially have a very small installed base, so few developers would be willing to take the risks in writing word-processing programs, spreadsheets, games, and other applications for that operating system. Because there would be very few applications available, consumers who did make the switch would have to bear the switching costs associated with giving up some of their applications—something that they might not be willing to do. Moreover, even if applications were available for the new operating system, consumers would have to bear the costs of purchasing those applications, another source of switching costs. In addition, they would have to bear the costs associated with learning to use the new operating system, yet another source of switching costs. Thus, many consumers would be unwilling to switch even if the new operating system performed better than Windows, and the company promoting the new operating system would thus be locked out of the market.

Consumers will bear switching costs if the benefits of adopting the new technology outweigh the costs of switching. For example, in the late 1980s and early 1990s, millions of people switched from analog record players to digital CD players even though the switching costs were significant: they had to purchase the new player technology, and many people purchased duplicate copies of their favorite music recordings. They nevertheless made the switch because for many people, the perceived benefit—the incredibly better sound quality associated with CDs—outweighed the costs of switching.

Strategy in Action 7.1

How Dolby Became the Standard in Sound Technology

Inventor Ray Dolby's name has become synonymous with superior sound in homes, movie theaters, and recording studios. The technology produced by his company, Dolby Laboratories, is part of nearly every music cassette and cassette recorder; prerecorded videotape; and, most recently, DVD movie disk and player. Since 1976, close to 1.5 billion audio products that use Dolby's technology have been sold worldwide. More than 44,000 movie theaters now show films in Dolby Digital Surround Sound, and some 50 million Dolby Digital home theater receivers have been sold since 1999. Dolby technology has become the de facto industry standard for high-quality sound in the music and film industry. How did Dolby build this technology franchise?

The story goes back to 1965, when Dolby Laboratories was founded in London by Ray Dolby (the company's headquarters moved to San Francisco in 1976). Dolby, who had a Ph.D. in physics from Cambridge University in England, had invented a technology for reducing the background hiss in professional tape recording without compromising the quality of the material being recorded. In 1968, Dolby reached an agreement to license his noise-reduction technology to KLH, a highly regarded American producer of audio equipment (record players and tape decks) for the consumer market. Soon other manufacturers of consumer equipment started to approach Dolby to license the technology. Dolby briefly considered manufacturing record players and tape decks for the consumer market, but as he later commented, "I knew that if we entered that market and tried to make something like a cassette deck, we would be in competition with any licensee that we took on. . . . So we had to stay out of manufacturing in that area in order to license in that area."

Dolby adopted a licensing business model and then had to determine what licensing fee to charge. He decided to charge a modest fee to reduce the incentive that manufacturers would have to develop their own technology. Then there was the question of which companies to license to. Dolby wanted the Dolby name associated with superior sound, so he needed to make sure that licensees adhered to quality standards. Therefore, the company set up a formal quality control program for its licensees' products. Licensees have to agree to have their products tested by Dolby, and the licensing agreement states that they cannot sell products that do not pass Dolby's quality tests. By preventing products with substandard performance from reaching the market, Dolby has maintained the quality image of products featuring Dolby technology and trademarks. Today, Dolby Laboratories tests samples of hundreds of licensed products every year under this program. By making sure that the Dolby name is associated with superior sound quality, Dolby's quality assurance strategy has increased the power of the Dolby brand, making it very valuable to license.

Another key aspect of Dolby's strategy was born in 1970 when Dolby began to promote the idea of releasing prerecorded cassettes encoded with Dolby noise-reduction technology so that they would have low noise when played on players equipped with Dolby noise-reduction technology. Dolby decided to license the technology on prerecorded tapes for free, instead collecting licensing fees just from the sales of tape players that used Dolby technology. This strategy was hugely successful and set up a positive feedback loop that helped to make Dolby technology ubiquitous. Growing sales of prerecorded tapes encoded with Dolby technology created a demand for players that contained Dolby technology, and as the installed base of players with Dolby technology grew, the proportion of prerecorded tapes that were encoded with Dolby technology surged, further boosting demand for players incorporating Dolby technology. By the mid-1970s, almost all prerecorded tapes were encoded with Dolby noise-reduction technology. This strategy remains in effect today for all media recorded with Dolby technology and encompasses not only videocassettes but also videogames and DVD releases encoded with Dolby Surround or Dolby Digital.

As a result of its licensing and quality assurance strategies, Dolby has become the standard for high-quality sound in the music and film industries. Although the company is small—its revenues were $327 million in 2005—its influence is large. It continues to push the boundaries of sound-reduction technology (it has been a leader in digital sound since the mid-1980s) and has successfully extended its noise-reduction franchise, first into films, then into DVD and videogame technology, and finally onto the Web, where it has licensed its digital technology to a wide range of media companies for digital music delivery and digital audio players, such as those built into personal computers and hand-held music players. Dolby has also licensed its technology for use in next-generation DVD players—high-definition DVDs.[a]

As this process started to get under way, a positive feedback loop started to develop, with the growing installed base of CD players leading to an increase in the number of music recordings issued on CDs, as opposed to or in addition to vinyl records. Past some point, the installed base of CD players got so big that music companies started to issue recordings only on CDs. Once this happened, even those who did not want to switch to the new technology were required to if they wished to purchase new music recordings. The industry standard had shifted: the new technology had locked in as the standard, and the old technology was locked out. It follows that despite its dominance, the Wintel standard for personal computers could one day be superseded if a competitor finds a way of providing sufficient benefits that enough consumers are willing to bear the switching costs associated with moving to a new operating system.

Strategies for Winning a Format War

From the perspective of a company pioneering a new technological standard in a marketplace where network effects and positive feedback loops operate, the key question becomes, "What strategy should we pursue to establish our format as the dominant one?" The various strategies that companies should adopt to win format wars revolve around *finding ways to make network effects work in their favor and against their competitors.* Winning a format war requires a company to build the installed base for its standard as rapidly as possible, thereby leveraging the positive feedback loop, inducing consumers to bear switching costs, and ultimately locking the market into its technology. It requires the company to jump-start and then accelerate demand for its technological standard or format so that it becomes established as quickly as possible as the industry standard, thereby locking out competing formats. Several key strategies and tactics can be adopted to try to achieve this.[6]

Ensure a Supply of Complements

It is important for the company to make sure that, in addition to the product itself, there is an adequate supply of complements. For example, no one will buy the Sony PlayStation 3 unless there is an adequate supply of games to run on that machine. And no one will purchase a Palm hand-held computer unless there are enough software applications to run on it. Companies normally take two steps to ensure an adequate supply of complements.

First, they may diversify into the production of complements and seed the market with sufficient supply to help jump-start demand for their format. Before Sony produced the original PlayStation in the early 1990s, it established its own in-house unit to produce videogames for the PlayStation. When it launched the PlayStation, Sony also simultaneously issued sixteen games to run on the machine, giving consumers a reason to purchase the format. Second, companies may create incentives or make it easy for independent companies to produce complements. Sony also licensed the right to produce games to a number of independent game developers, charged the developers a lower royalty rate than they had to pay to competitors such as Nintendo and Sega, and provided them with software tools that made it easier for them to develop the games. Thus, the launch of the Sony PlayStation was accompanied by the simultaneous launch of thirty or so games, which quickly helped to stimulate demand for the machine.

Leverage Killer Applications

Killer applications are applications or uses of a new technology or product that are so compelling that they persuade customers to adopt the new format or technology in droves, thereby "killing" demand for competing formats. Killer applications often help to jump-start demand for the new standard. For example, in the late 1990s, hand-held computers based on the Palm operating system became the dominant format in the market for personal digital assistants (PDAs). The killer applications that drove adoption of the Palm format were the personal information management functions and a pen-based input medium (based on Graffiti) that Palm bundled with its original PalmPilot, which it introduced in 1996. There had been PDAs before the PalmPilot, including Apple Computer's ill-fated Newton, but the applications and ease of use of the PalmPilot persuaded many consumers to enter this market. Within eighteen months of its initial launch, more than 1 million PalmPilots had been sold, making for a faster demand ramp-up than occurred for the first cell phones and pagers. Similarly, the killer applications that induced consumers to sign up for online services such as AOL were email, chatrooms, and the ability to browse the Web.

Ideally, the company promoting a technological standard will want to develop the killer applications itself—that is, develop the appropriate complementary products, as Palm did with the PalmPilot. However, it may also be able to leverage the applications that others develop. For example, the early sales of the IBM PC following its 1981 introduction were driven primarily by IBM's decision to license two important software programs for the PC, VisiCalc (a spreadsheet program) and Easy Writer (a word-processing program), both developed by independent companies. IBM saw that they were driving rapid adoption of rival personal computers, such as the Apple II, so it quickly licensed them, produced versions that would run on the IBM PC, and sold them as complements to the IBM PC, a strategy that was to prove very successful.

• Aggressively Price and Market

A common tactic to jump-start demand is to adopt a **razor and blade strategy**: pricing the product (razor) low in order to stimulate demand and increase the installed base, and then trying to make high profits on the sale of complements (razor blades), which are priced relatively high. This strategy owes its name to the fact that it was pioneered by Gillette to sell its razors and razor blades. Many other companies have followed this strategy—for example, Hewlett-Packard typically sells its printers at cost but makes significant profits on the subsequent sale of its replacement cartridges. In this case, the printer is the "razor," and it is priced low to stimulate demand and induce consumers to switch from their existing printer; the cartridges are the "blades," which are priced high to make profits. The inkjet printer represents a proprietary technological format because only Hewlett-Packard cartridges can be used with the printers, and not cartridges designed for competing inkjet printers, such as those sold by Canon. A similar strategy is used in the videogame industry: manufacturers price videogame consoles at cost to induce consumers to adopt their technology, while making profits on the royalties they receive from the sales of games that run on their system.

Aggressive marketing is also a key factor in jump-starting demand to get an early lead in an installed base. Substantial upfront marketing and point-of-sales promotion techniques are often used to try to get potential early adopters to bear the switching costs associated with adopting the format. If these efforts are successful, they can be the start of a positive feedback loop. Again, the Sony PlayStation provides a good example. Sony linked the introduction of the PlayStation with nationwide television advertising aimed at its primary demographic (eighteen- to thirty-four-year-olds) and in-store displays that allowed potential buyers to play games on the machine before making a purchase.

• Cooperate with Competitors

Companies have been close to simultaneously introducing competing and incompatible technological standards a number of times. A good example is the compact disk. Initially four companies—Sony, Philips, JVC, and Telefunken—were developing CD players using different variations of the underlying laser technology. If this situation had persisted, they might have ultimately introduced incompatible technologies into the marketplace, so a CD made for a Philips CD player would not play on a Sony CD player. Understanding that the nearly simultaneous introduction of such incompatible technologies can create significant confusion among consumers and often leads them to delay their purchases, Sony and Philips decided to join forces with each other and cooperate on developing the technology. Sony contributed its error-correction technology, and Philips contributed its laser technology. The result of this cooperation was that momentum among other players in the industry shifted toward the Sony-Philips alliances; JVC and Telefunken were left with little support. Most importantly, recording labels announced that they would support the Sony-Philips format but not the Telefunken or JVC format. Telefunken and JVC subsequently decided to abandon their efforts to develop CD technology. The cooperation between Sony and Philips was important because it reduced confusion in the industry and allowed a single format to come to the fore, which speeded up adoption of the technology. The cooperation was a win-win situation for both Philips and Sony, which eliminated the competitors and allowed them to share in the success of the format.

License the Format

Another strategy often adopted is to license the format to other enterprises so that they can produce products based on it. The company that pioneered the format gains from the licensing fees and from the enlarged supply of the product, which can stimulate demand and help accelerate market adoption. This was the strategy that Matsushita adopted with its VHS format for the videocassette recorder. In addition to producing VCRs at its own factory in Osaka, Matsushita let a number of other companies produce VHS format players under license (Sony decided not to license its competing Betamax format and produced all Betamax format players itself), and so VHS players were more widely available. More people purchased VHS players, which created an incentive for film companies to issue more films on VHS tapes (as opposed to Betamax tapes), which further increased demand for VHS players, and hence helped Matsushita to lock in VHS as the dominant format in the marketplace. Sony, ironically the first to market, saw its position marginalized by the reduced supply of the critical complement, prerecorded films, and ultimately withdrew Betamax players from the consumer marketplace.

As we saw in Strategy in Action 7.1, Dolby adopted a similar licensing strategy to get its noise-reduction technology adopted as the technological standard in the music and film industries. By charging a modest licensing fee for use of the technology in recording equipment and forgoing licensing fees on media recorded using Dolby technology, Dolby deliberately sought to reduce the financial incentive that potential competitors might have to develop their own, possibly superior, technology. Dolby calculated that its long-run profitability would be maximized by adopting a licensing strategy that limited the incentive of competitors to enter the market.

The correct strategy to pursue in a particular scenario requires that the company consider all of these different strategies and tactics and pursue those that seem most appropriate given the competitive circumstances prevailing in the industry and the likely strategy of rivals. Although no mix of strategies and tactics can be called the best, the company must keep the goal of rapidly increasing the installed base of products based on its standard as the primary goal. By helping to jump-start demand for its format, a company can induce consumers to bear the switching costs associated with adopting its technology and leverage any positive feedback process that might exist. Also important is not pursuing strategies that have the opposite effect. For example, pricing high to capture profits from early adopters, who tend not to be as price sensitive as later adopters, can have the unfortunate effect of slowing demand growth and letting a more aggressive competitor pick up market share and establish its format as the industry standard.

Costs in High-Technology Industries

In many high-tech industries, the fixed costs of developing the product are very high, but the costs of producing one extra unit of the product are very low. This is most obvious in the case of software. For example, it reportedly cost Microsoft \$5 billion to develop Windows Vista, the latest version of its Windows operating system, but the cost of producing one more copy of Windows Vista is virtually zero. Once Windows Vista was completed, Microsoft produced master disks that it sent out to PC manufacturers, such as Dell Computer, which then loaded a copy of Windows Vista onto every PC it sold. The cost to Microsoft was effectively zero, and yet it receives a significant licensing fee for each copy of Windows Vista installed on a PC.[7] For Microsoft, the marginal cost of making one more copy of Windows Vista is close to zero, although the fixed costs of developing the product are \$5 billion.

Many other high-technology products have similar cost economics: very high fixed costs and very low marginal costs. Most software products share these features, although if the software is sold through stores, the costs of packaging and distribution will raise the marginal costs, and if it is sold by a sales force direct to end-users, this too will raise the marginal costs. Many consumer electronics products have the same basic economics. The fixed costs of developing a DVD player or a videogame console can be very expensive, but the costs of producing an incremental unit are very low. The costs of developing a new drug, such as Viagra, can run to over \$800 million, but the marginal cost of producing each additional pill is at most a few cents.

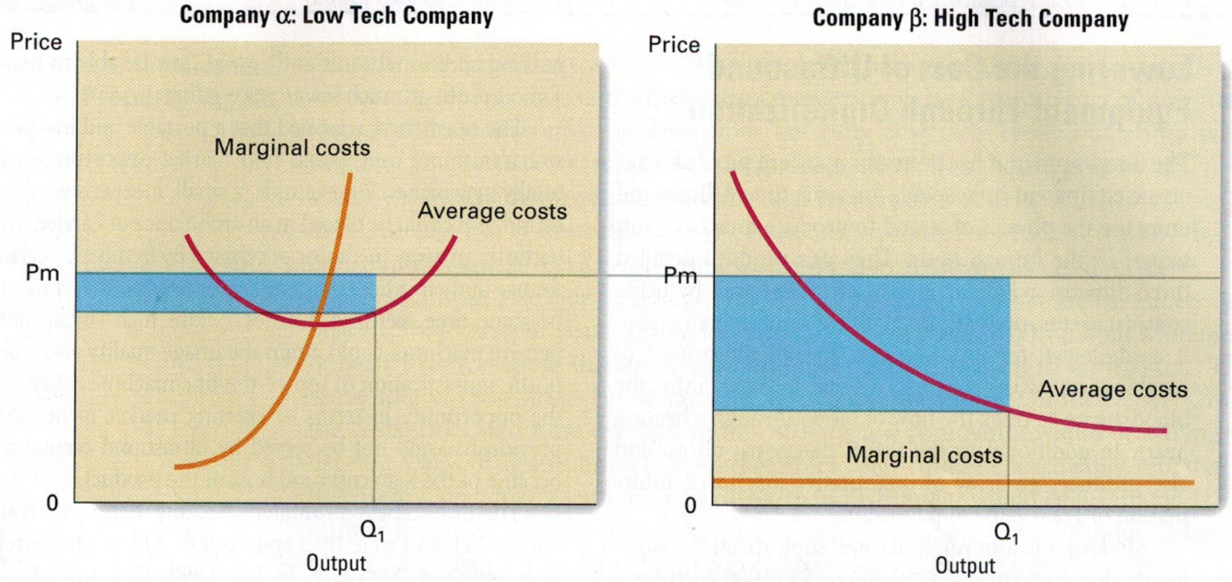
Comparative Cost Economics

To grasp why this cost structure is strategically important, a company must understand that, in many industries, marginal costs rise as a company tries to expand output (economists call this the *law of diminishing returns*). To produce more of a good, a company has to hire more labor and invest in more plant and machinery. At the margin, the additional resources used are not as productive, so this leads to increasing marginal costs. However, the law of diminishing returns often does not apply in many high-tech settings, such as the production of software or sending one more bit of data down a digital telecommunications network.

Consider two companies, α and β (see Figure 7.3). Company α is a conventional producer and faces diminishing returns, so as it tries to expand output, its marginal costs rise. Company β is a high-tech producer, and its marginal costs do not rise at all as output is increased. Note that in Figure 7.3, company β's marginal cost curve is drawn as a straight line near the horizontal axis, implying that marginal costs are close to zero and do not vary with output, whereas company α's marginal costs rise as output is expanded, illustrating diminishing returns. Company β's flat and low marginal cost curve means that its average cost curve will fall continuously over all ranges of output as it spreads its fixed costs out over greater volume. In contrast, the rising marginal costs encountered by company α mean that its average cost curve is the U-shaped curve familiar from basic economics texts. For simplicity, assume that both companies sell their product at the same price, Pm, and both sell exactly the same quantity of output, 0 (Q1). You can see from Figure 7.3 that at an output of Q1, company β has much lower average costs than company α and as a consequence is making far more profit (profit is the shaded area in Figure 7.3).

FIGURE 7.3

Cost Structures in High-Technology Industries



Strategic Significance

If a company can shift from a cost structure where it encounters increasing marginal costs to one where fixed costs may be high but marginal costs are much lower, its profitability may increase. In the consumer electronics industry, such a shift has been playing out for two decades. Music recordings used to be based on analog technology, where marginal costs rose as output expanded due to diminishing returns (as in the case of company α in Figure 7.3). Since the 1980s, digital systems such as CD players have replaced analog systems. Digital systems are software based, and this implies much lower marginal costs of producing one more copy of a recording. As a result, the music labels have been able to lower prices, expand demand, and see their profitability increase (their production system has more in common with company β in Figure 7.3).

This process is still unfolding. The latest technology for making copies of music recordings is based on distribution over the Internet (for example, by downloading onto an iPod). Here, the marginal costs of making one more copy of a recording are lower still. In fact, they are close to zero and do not increase with output. The only problem is that the low costs of copying and distributing music recordings have created a copyright problem that the major music labels have yet to solve (we discuss this in more detail shortly when we consider intellectual property rights). The same shift is now beginning to affect other industries. Some companies are building their strategies around trying to exploit and profit from this shift. For an example, see Strategy in Action 7.2, which looks at SonoSite.

When a high-tech company faces high fixed costs and low marginal costs, its strategy should emphasize the low-cost option: deliberately drive prices down to drive volume up. Look again at Figure 7.3 and you will see that the high-tech company's average costs fall rapidly as output expands. This implies that prices can be reduced to stimulate demand, and as long as prices fall less rapidly than average costs, per-unit profit margins will expand as prices fall. This is a consequence of the fact

Strategy in Action 7.2

Lowering the Cost of Ultrasound Equipment Through Digitalization

The ultrasound unit has been an important piece of diagnostic equipment in hospitals for some time. Ultrasound units use the physics of sound to produce images of soft tissues in the human body. They can produce detailed three-dimensional color images of organs and, by using contrast agents, track the flow of fluids through an organ. A cardiologist, for example, can use an ultrasound in combination with contrast agents injected into the bloodstream to track the flow of blood through a beating heart. In additional to the visual diagnosis, ultrasound also produces an array of quantitative diagnostic information of great value to physicians.

Modern ultrasound units are sophisticated instruments that cost around $250,000 to $300,000 each for a top-line model. They are fairly bulky instruments, weighing some 300 pounds, and are wheeled around hospitals on carts.

A few years back, a group of researchers at ATL, one of the leading ultrasound companies, came up with an idea for reducing the size and cost of a basic unit. They theorized that it might be possible to replace up to 80% of the solid circuits in an ultrasound unit with software, in the process significantly shrinking the size and reducing the weight of machines and thereby producing portable ultrasound units. Moreover, by digitalizing much of the ultrasound (replacing hardware with software), they could considerably drive down the marginal costs of making additional units and would thus be able to make a good profit at much lower price points.

The researchers reasoned that a portable and inexpensive ultrasound unit would find market opportunities in totally new niches. For example, a small, inexpensive ultrasound unit could be placed in an ambulance or carried into battle by an army medic, or purchased by family physicians for use in their offices. Although they realized that it would be some time, perhaps decades, before such small, inexpensive machines could attain the image quality and diagnostic sophistication of top-of-the-line machines, they saw the opportunity in terms of creating market niches that previously could not be served by ultrasound companies because of the high costs and bulk of the product.

The researchers ultimately became a project team within ATL and were then spun out of ATL as an entirely new company, SonoSite. In late 1999, they introduced their first portable product, weighing just six pounds and costing around $25,000. SonoSite targeted niches that full-sized ultrasound products could not reach: ambulatory care and foreign markets that could not afford the more expensive equipment. In 2005, the company sold $150 million worth of its product.

In the long run, SonoSite plans to build more features and greater image quality into the small hand-held machines, primarily by improving the software. This could allow the units to penetrate U.S. hospital markets that currently purchase the established technology, much as client-server systems based on PC technology came to replace mainframes for some functions in business corporations.[b]

that the firm's marginal costs are low and do not rise with output. This strategy of pricing low to drive volume up and reap wider profit margins is central to the business model of some very successful high-technology companies, including Microsoft.

Managing Intellectual Property Rights

Ownership of a technology can be a source of sustained competitive advantage and superior profitability, particularly when the company owns a technology that is the standard in an industry, such as Microsoft and Intel's Wintel standard for personal computers and Dolby's ownership of the standard for noise-reduction technology in the music and film recording industries. Even if a technology is not standard but is valued by a sufficient number of consumers, ownership of that technology can still be very profitable. Apple's current personal computer technology is by no means the standard in the marketplace, much as Apple would like it to be. In fact, the company's iMac technology accounted for only about 5% of the personal computers sold in 2006. But that small slice of a very large market is still a valuable niche for Apple.

Intellectual Property Rights

Because new technology is the product of intellectual and creative effort, we call it intellectual property. The term **intellectual property** refers to the product of any intellectual and creative effort and includes not only new technology but also a wide range of intellectual creations, including music, films, books, and graphic art. As a society, we value the products of intellectual and creative activity. Intellectual property is seen as a very important driver of economic progress and social wealth.[8] But it is also often expensive, risky, and time-consuming to create intellectual property.

For example, a new drug to treat a dangerous medical condition such as cancer can take twelve to sixteen years to develop and cost as much as $800 million. Moreover, only 20% of new drugs that are tested in humans actually make it to the market.[9] The remainder of these drugs fail because they are found to be unsafe or ineffective. Given the costs, risks, and time involved in this activity, few companies would be willing to develop a new drug and bring it to market unless they could be reasonably sure that if they were successful in developing the drug, their investment would be profitable. If the minute they introduced a successful cancer drug, their competitors produced imitations of that drug, no company would even consider making the initial investment.

To make sure that this does not happen, we grant the creators of intellectual property certain rights over their creation. These rights, which stop competitors from copying or imitating the creation for a number of years, take the legal forms of patents, copyrights, and trademarks, which all serve the same basic objective: to give individuals and companies an incentive to engage in the expensive and risky business of creating new intellectual property.

The creation of intellectual property is a central endeavor in high-technology industries, and the management of intellectual property rights has moved to center stage in many of these companies. Developing strategies to protect and enforce intellectual property rights can be an important aspect of competitive advantage. For many companies, this amounts to making sure that their patents and copyrights are respected. It is not uncommon, therefore, to see high-technology companies bringing lawsuits against their competitors for patent infringement. In general, companies often use such lawsuits not only to sanction those they suspect of violating the company's intellectual property rights, but also to signal to potential violators that the company will aggressively defend its property. Legal action alone suffices to protect intellectual property in many industries, but in others, such as software, the low costs of illegally copying and distributing intellectual property call for more creative strategies to manage intellectual property rights.

Digitalization and Piracy Rates

Protecting intellectual property has become more complicated in the past few decades because of **digitalization**, that is, the rendering of creative output in digital form. This can be done for music recordings, films, books, newspapers, magazines, and computer software. Digitalization has dramatically lowered the cost of copying and distributing digitalized intellectual property or digital media. As we have seen, the marginal cost of making one more copy of a software program is very low, and the same is true for any other intellectual property rendered in digital form. Moreover, digital media can be distributed at a very low cost (again, almost zero), for example, by distributing over the Internet. Reflecting on this, one commentator has described the

Internet as a "giant out-of-control copying machine."[10] The low marginal costs of copying and distributing digital media have made it very easy to sell illegal copies of such property. In turn, this has helped to produce a high level of piracy (in this context, piracy refers to the theft of intellectual property).

The International Federation of the Phonographic Industry claims that about one-third of all recorded music products sold worldwide in 2005 were pirated (illegal) copies, suggesting that piracy costs the industry over $4.5 billion annually.[11] The computer software industry also suffers from lax enforcement of intellectual property rights. Estimates suggest that violations of intellectual property rights cost personal computer software firms revenues equal to $35 billion in 2005.[12] According to the Business Software Alliance, a software industry association, in 2005, some 35% of all software applications used in the world were pirated. The worst region was Latin America, where the piracy rate was 68% (see Figure 2.2). One of the worst countries was China, where the piracy rate in 2005 ran at 86% and cost the industry more than $3.9 billion in lost sales, up from $444 million in 1995. Although at 21% the piracy rate was much lower in the United States, the value of sales lost was more significant because of the size of the market, reaching an estimated $6.9 billion in 2005.[13]

The scale of this problem is so large that simply resorting to legal tactics to enforce intellectual property rights has amounted to nothing more than a partial solution to the piracy problem. Many companies now build sophisticated encryption software into their digital products, which can make it more difficult for pirates to copy digital media and thereby can raise the costs of stealing. But the pirates too are sophisticated and often seem to be able to find their way around encryption software. This raises the question of whether there are additional strategies that can be adopted to manage digital rights and thereby limit piracy.

Strategies for Managing Digital Rights

One strategy is simply to recognize that while the low costs of copying and distributing digital media make some piracy inevitable, the same attributes can be used to the company's advantage.[14] The basic strategy here represents yet another variation of the basic razor and blades principle: give something away for free to boost the sales of a complementary product. A familiar example concerns Adobe Acrobat Reader, the software program for reading documents formatted by Adobe Acrobat (that is, PDF-formatted documents). Adobe developed Adobe Acrobat to allow people to format documents in a manner that resembled a high-quality printed page and to display and distribute these documents over the Web. Moreover, Adobe documents are formatted in a read-only format, meaning that they cannot be altered by individuals, nor can parts of those documents be copied and pasted to other documents. Its strategy has been to give away Adobe Acrobat Reader for free and then make money by selling its Acrobat software for formatting documents. The strategy has worked extremely well. Anyone can download a copy of Acrobat Reader from Adobe's website. Because the marginal costs of copying and distributing this software over the Web are extremely low, the process is almost free for both Adobe and its customers. The result is that the Acrobat Reader has diffused very rapidly and is now the dominant format for viewing high-quality documents distributed and downloaded over the Web. As the installed base of Acrobat Readers has grown, sales of Adobe Acrobat software have soared as more and more organizations and individuals realize that formatting their digital documents in Acrobat makes sense.

Another strategy is to take advantage of the low costs of copying and distributing digital media to drive down the costs of purchasing those media, thereby reducing the incentive that consumers have to steal. When coupled with encryption software that makes piracy more difficult and vigorous legal actions to enforce intellectual property regulations, this can slow the piracy rate and generate incremental revenues that cost little to produce. A third strategy might be to alter the firm's business model in a way that makes piracy more difficult. As discussed in Strategy in Action 7.3, the videogame industry has seen a shift from selling games outright, to renting them online.

Strategy in Action 7.3

Battling Piracy in the Videogame Industry

Over the past decade, the videogame industry has grown into a global colossus worth more than $25 billion a year in revenues. For the three biggest players in the industry, Sony with its PlayStation, Microsoft with Xbox, and Nintendo, this potentially represents a huge growth engine, but the engine is threatened by a rise in piracy, which cost the videogame industry an estimated $4 billion in 2005.

The piracy problem is particularly serious in East Asia (except for Japan), where videogame consoles are routinely "chipped"—sold with modified chips, called mod chips, that override the console's security system, allowing it to play illegally copied games and CDs. Importers or resellers, who charge a small markup for making the modification, illegally install the mod chips. In some areas, such as Hong Kong, it is almost impossible to find a console that hasn't been modified.

Because they allow users to play illegally copied games, consoles with mod chips offer a gaping gateway for software pirates, and they directly threaten the profitability of console and game makers. The big three in the industry all follow a razor and blades business model, where the console (razor) is sold at a loss, and profit is made on the sale of the game (razor blades). In the case of Microsoft's Xbox, estimates suggest the company loses as much as $200 on each Xbox it sells. To make profits, Microsoft collects royalties on the sale of games developed under license, in addition to producing and selling some games itself. Games typically retail for about $50, and Microsoft must sell six to twelve games to each Xbox user to recoup the $200 loss on the initial sale and start making a profit. If those users are purchasing pirated games and playing them on "chipped" Xbox consoles, Microsoft collects nothing in royalties and may never reach the breakeven point. Sony and Nintendo face similar problems. In East Asia, some 70% of game software sold in the region may be pirated thanks to the popularity of "chipped" consoles and the low price of pirated games, which may sell for one-third the price of the legal game.

Historically, all the big videogame companies tried to deal with the piracy problem in East Asia by ignoring the market. Sony launched its PlayStation II in East Asia two years after its Japanese launch, and Microsoft delayed its East Asian launch for a year after it launched elsewhere in the world. But this tactic is increasingly questionable in a region where there may soon be more gamers than in the United States. Industry estimates suggest that Asian gamers spent more on videogame software in 2005 than U.S. gamers did, much of it on low-priced pirated games.

Another tactic that both Sony and Microsoft are now using is to regularly alter the hardware specifications of its consoles, rendering the existing mod chips useless. But the companies have found this is just a temporary solution: within a few weeks, mod chips made to override the new specifications are available on the market.

A third tactic is to push local authorities to legally enforce existing intellectual property rights law that in theory outlaws the mod chip practice. For example, Microsoft, Sony, and Nintendo joined forces to sue the Hong Kong company, Lik Sang, which sells mod chips through its website and is one of the world's largest distributors of the chips. Some observers question the value of this tactic, however; they argue that if Lik Sang is shut down, many others in Hong Kong may be willing to take its place. What is needed, they argue, is concerted government action to stop the pirates, and so far East Asian governments have not been quick to act.

A final way of dealing with piracy is to change the business model. All three main players in the industry are now starting to push online games, where customers pay a subscription fee to play online, as opposed to a one-time fee to purchase a game. This business model makes piracy much less of an issue and it may drive growth forward in places like China, where piracy is endemic. Indeed, current estimates suggest that there are already 29 million gamers in China, most of whom play pirated games, and that this figure will increase to 55 million by 2009. If a good percentage switch to online gaming, the revenues could be significant.[c]

Capturing First-Mover Advantages

In high-technology industries, companies often compete by striving to be the first to develop revolutionary new products, that is, to be a **first mover**. By definition, the first mover, with regard to a revolutionary product, is in a monopoly position. If the new product satisfies unmet consumer needs and demand is high, the first mover can capture significant revenues and profits. Such revenues and profits signal to potential rivals that there is money to be made by imitating the first mover. As illustrated in Figure 7.4, in the absence of strong barriers to imitation, this implies that imitators will rush into the market created by the first mover, competing for the first mover's monopoly profits and leaving all participants in the market with a much lower level of returns.

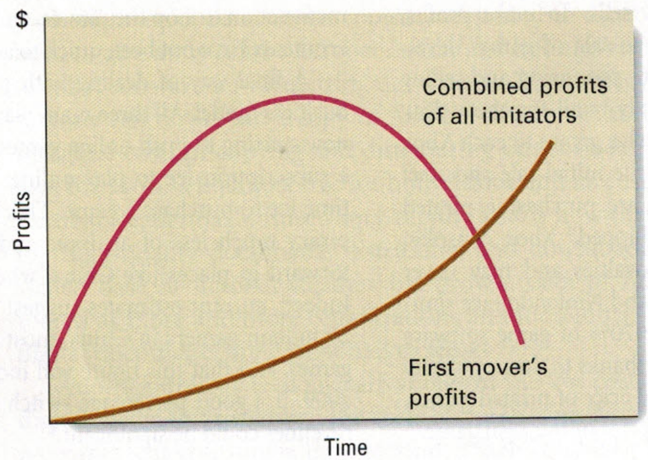
Despite imitation, some first movers have the ability to capitalize on and reap substantial first-mover advantages—the advantages of pioneering new technologies and products that lead to an enduring competitive advantage. Intel introduced the world's first microprocessor in 1971 and today still dominates the microprocessor segment of the semiconductor industry. Xerox introduced the world's first photocopier and for a long time enjoyed a leading position in the industry. Cisco introduced the first Internet protocol network router in 1986 and still dominates the market for that equipment today. Some first movers can reap substantial advantages from their pioneering activities that lead to an enduring competitive advantage. They can, in other words, limit or slow the rate of imitation.

But there are plenty of counterexamples suggesting that first-mover advantages might not be easy to capture and, in fact, that there might be **first-mover disadvantages**—the competitive disadvantages associated with being first. For example, Apple Computer was the first company to introduce a hand-held computer, the Apple Newton, but the product failed; a second mover, Palm, succeeded where Apple had failed. In the market for commercial jet aircraft, DeHavilland was first to market with the Comet, but the second mover, Boeing, with its 707 jetliner, went on to dominate the market.

Clearly, being a first mover does not by itself guarantee success. As we shall see, the difference between innovating companies that capture first-mover advantages and those that fall victim to first-mover disadvantages in part turns on the strategy that the first mover pursues. Before considering the strategy issue, however, we need to take a closer look at the nature of first-mover advantages and disadvantages.[15]

FIGURE 7.4

The Impact of Imitation on the Profits of a First Mover



First-Mover Advantages

There are five main sources of first-mover advantages.[16] First, the first mover has an opportunity to exploit network effects and positive feedback loops, locking consumers into its technology. In the VCR industry, Sony could have exploited network effects by licensing its technology, but instead the company ceded its first-mover advantage to the second mover, Matsushita.

Second, the first mover may be able to establish significant brand loyalty, which is expensive for later entrants to break down. Indeed, if the company is successful in this endeavor, its name may become closely associated with the entire class of products, including those produced by rivals. People still talk of "Xeroxing" when they are going to make a photocopy or "FedExing" when they are going to send a package by overnight delivery.

Third, the first mover may be able to ramp up sales volume ahead of rivals and thus reap cost advantages associated with the realization of scale economies and learning effects (see Chapter 4). Once the first mover has these cost advantages, it can respond to new entrants by cutting prices to hold on to its market share and still earn significant profits.

Fourth, the first mover may be able to create switching costs for its customers that subsequently make it difficult for rivals to enter the market and take customers away from the first mover. Wireless service providers, for example, will give new customers a "free" wireless phone, but customers must sign a contract agreeing to pay for the phone if they terminate the service contract within a specified time period, such as a year. Because the real cost of a wireless phone may run from $100 to $200, this represents a significant switching cost that later entrants have to overcome.

Finally, the first mover may be able to accumulate valuable knowledge related to customer needs, distribution channels, product technology, process technology, and so on. This accumulated knowledge gives it a knowledge advantage that later entrants might find difficult or expensive to match. Sharp, for example, was the first mover in the commercial manufacture of active matrix liquid crystal displays used in laptop computers. The process for manufacturing these displays is very difficult, with a high reject rate for flawed displays. Sharp has accumulated such an advantage with regard to production processes that it has been very difficult for later entrants to match it on product quality, and thus costs.

First-Mover Disadvantages

Balanced against these first-mover advantages are a number of disadvantages.[17] First, the first mover has to bear significant pioneering costs that later entrants do not. The first mover has to pioneer the technology, develop distribution channels, and educate customers about the nature of the product. All of this can be expensive and time-consuming. Later entrants, by way of contrast, might be able to free-ride on the first mover's investments in pioneering the market and customer education.

Related to this, first movers are more prone to make mistakes because there are so many uncertainties in a new market. Later entrants may be able to learn from the mistakes made by first movers, improve on the product or the way in which it is sold, and come to market with a superior offering that captures significant market share from the first mover. For example, one of the reasons that the Apple Newton failed was that the handwriting software in the hand-held computer failed to recognize human handwriting. The second mover in this market, Palm, learned from Apple's error. When it introduced the PalmPilot, it used software that recognized letters written in a particular way, Graffiti, and then persuaded customers to learn this method of inputting data into the hand-held computer.

Third, first movers run the risk of building the wrong resources and capabilities because they are focusing on a customer set that is not going to be characteristic of the mass market. This is the crossing-the-chasm problem that we discussed in the previous chapter. Recall that the customers in the early market—those we categorized as innovators and early adopters—have different characteristics from the first wave of the mass market, the early majority. The first mover runs the risk of gearing its resources and capabilities to the needs of innovators and early adopters and not being able to switch when members of the early majority enter the market. As a result, first movers run a greater risk of plunging into the chasm that separates the early market from the mass market.

Finally, the first mover may invest in inferior or obsolete technology. This can happen when its product innovation is based on underlying technology that is advancing rapidly. By basing its product on an early version of the technology, it may lock itself into something that rapidly becomes obsolete. In contrast, later entrants may be able to leapfrog the first mover and introduce products that are based on later versions of the underlying technology. This happened in France during the 1980s when, at the urging of the government, France Telecom introduced the world's first consumer online service, Minitel. France Telecom distributed crude terminals to consumers for free, which they could hook up to their phone line and use to browse phone directories. Other simple services were soon added, and before long the French could conduct online shopping, banking, travel, weather, and news—all years before the Web was invented. The problem was that by the standards of the Web, Minitel was very crude and inflexible, and France Telecom, as the first mover, suffered. The French were very slow to adopt personal computers and then the Internet primarily because Minitel had such a presence. As late as 1998, only one-fifth of French households had a computer, compared with two-fifths in the United States, and only 2% of households were connected to the Internet, compared to over 30% in the United States. As the result of a government decision, France Telecom, and indeed an entire nation, was slow to adopt a revolutionary new online medium, the Web, because they were the first to invest in a more primitive version of the technology.[18]

Strategies for Exploiting First-Mover Advantages

The task facing a first mover is how to exploit its lead to capitalize on first-mover advantages and build a sustainable long-term competitive advantage while simultaneously reducing the risks associated with first-mover disadvantages. There are three basic strategies available: (1) develop and market the innovation itself, (2) develop and market the innovation jointly with other companies through a strategic alliance or joint venture, and (3) license the innovation to others and let them develop the market.

The optimal choice of strategy depends on the answers to three questions:

1. Does the innovating company have the complementary assets to exploit its innovation and capture first-mover advantages?
2. How difficult is it for imitators to copy the company's innovation? In other words, what is the height of the barriers to imitation?
3. Are there capable competitors that could rapidly imitate the innovation?

Complementary Assets Complementary assets are the assets required to exploit a new innovation and gain a competitive advantage.[19] Among the most important complementary assets are competitive manufacturing facilities capable of handling rapid growth in customer demand while maintaining high product quality. State-of-the-art manufacturing facilities enable the first mover to move quickly down the experience curve without encountering production bottlenecks or problems with the quality of the product. The inability to satisfy demand because of these problems, however, creates the opportunity for imitators to enter the marketplace. For example, in 1998, Immunex was the first company to introduce a revolutionary new biological treatment for rheumatoid arthritis. Sales for this product, Enbrel, ramped up very rapidly, hitting $750 million in 2001. However, Immunex had not invested in sufficient manufacturing capacity. In mid-2000, it announced that it lacked the capacity to satisfy demand and that creating additional capacity would take at least two years. This manufacturing bottleneck gave the second mover in the market, Johnson & Johnson, the opportunity to expand demand for its product rapidly, which was outselling Enbrel by early 2002. Immunex's first-mover advantage had been partly eroded because it lacked an important complementary asset, the manufacturing capability required to satisfy demand.

Complementary assets also include marketing know-how, an adequate sales force, access to distribution systems, and an after-sales service and support network. All of these assets can help an innovator build brand loyalty and achieve market penetration more rapidly.[20] In turn, the resulting increases in volume facilitate more rapid movement down the experience curve and the attainment of a sustainable cost-based advantage due to scale economies and learning effects. One of the reasons that EMI, the first mover in the market for CT scanners, ultimately lost out to established medical equipment companies, such as GE Medical Systems, was that it lacked the marketing know-how, sales force, and distribution systems required to compete effectively in the world's largest market for medical equipment, the United States.

Developing complementary assets can be very expensive, and companies often need large infusions of capital for this purpose. That is why first movers often lose out to late movers that are large, successful companies in other industries with the resources to develop a presence in the new industry quickly. Microsoft and 3M exemplify companies that can move quickly to capitalize on the opportunities when other companies open up new product markets, such as compact disks or floppy disks. For example, although Netscape pioneered the market for Internet browsers with the Netscape Navigator, Microsoft's Internet Explorer ultimately dominated the market for Internet browsers.

Height of Barriers to Imitation Recall from Chapter 3 that barriers to imitation are factors that prevent rivals from imitating a company's distinctive competencies and innovations. Although ultimately any innovation can be copied, the higher the barriers are, the longer it takes for rivals to imitate, and the more time the first mover has to build an enduring competitive advantage.

Barriers to imitation give an innovator time to establish a competitive advantage and build more enduring barriers to entry in the newly created market. Patents, for example, are among the most widely used barriers to imitation. By protecting its photocopier technology with a thicket of patents, Xerox was able to delay any significant imitation of its product for seventeen years. However, patents are often easy to "invent around." For example, one study found that this happened to 60% of patented innovations within four years.[21] If patent protection is weak, a company might try to slow imitation by developing new products and processes in secret. The most famous example of this approach is Coca-Cola, which has kept the formula for Coke a secret for generations. But Coca-Cola's success in this regard is an exception. A study of 100 companies has estimated that proprietary information about a company's decision to develop a major new product or process is known to its rivals within about twelve to eighteen months of the original development decision.[22]

Capable Competitors **Capable competitors** are companies that can move quickly to imitate the pioneering company. Competitors' capability to imitate a pioneer's innovation depends primarily on two factors: (1) research and development (R&D) skills and (2) access to complementary assets. In general, the greater the number of capable competitors with access to the R&D skills and complementary assets needed to imitate an innovation, the more rapid imitation is likely to be.

In this context, R&D skills refer to the ability of rivals to reverse-engineer an innovation to find out how it works and quickly develop a comparable product. As an example, consider the CT scanner. GE bought one of the first CT scanners produced by EMI, and its technical experts reverse-engineered it. Despite the product's technological complexity, GE developed its own version, which allowed it to imitate EMI quickly and ultimately to replace EMI as the major supplier of CT scanners.

With regard to complementary assets, the access that rivals have to marketing, sales know-how, or manufacturing capabilities is one of the key determinants of the rate of imitation. If would-be imitators lack critical complementary assets, not only do they have to imitate the innovation, but they may also have to imitate the innovator's complementary assets. This is expensive, as AT&T discovered when it tried to enter the personal computer business in 1984. AT&T lacked the marketing assets (sales force and distribution systems) necessary to support personal computer products. The lack of these assets and the time it takes to build them partly explain why, four years after it entered the market, AT&T had lost $2.5 billion and still had not emerged as a viable contender. It subsequently pulled out of this business.

Three Innovation Strategies The way in which these three factors—complementary assets, height of barriers to imitation, and the capability of competitors—influence the choice of innovation strategy is summarized in Table 7.1. The competitive strategy of developing and marketing the innovation alone makes most sense when (1) the innovator has the complementary assets necessary to develop the innovation, (2) the barriers to imitating a new innovation are high, and (3) the number of capable competitors is limited. Complementary assets allow rapid development and promotion of the innovation. High barriers to imitation buy the innovator time to establish a competitive advantage and build enduring barriers to entry through brand loyalty or experience-based cost advantages. The fewer the capable competitors, the less likely it is that any one of them will succeed in circumventing barriers to imitation and quickly imitating the innovation.

TABLE 7.1

Strategies for Profiting from Innovation

Strategy	Does the Innovator Have the Required Complementary Assets?	What Is the Likely Height of Barriers to Imitation?	How Many Capable Competitors Exist in the Industry?
Going it alone	Yes	High	Very few
Entering into an alliance	No	High	Moderate number
Licensing the innovation	No	Low	Many

The competitive strategy of developing and marketing the innovation jointly with other companies through a strategic alliance or joint venture makes most sense when (1) the innovator lacks complementary assets, (2) barriers to imitation are high, and (3) there are several capable competitors. In such circumstances, it makes sense to enter into an alliance with a company that already has the complementary assets—in other words, with a capable competitor. Theoretically, such an alliance should prove to be mutually beneficial, and each partner can share in high profits that neither could earn on its own. Moreover, such a strategy has the benefit of co-opting a potential rival. For example, had EMI teamed up with a capable competitor to develop the market for CT scanners, such as GE Medical Systems, instead of going it alone, the company might not only have been able to build a more enduring competitive advantage, but it would also have co-opted a potentially powerful rival into its camp.

The third strategy, licensing, makes most sense when (1) the innovating company lacks the complementary assets, (2) barriers to imitation are low, and (3) there are many capable competitors. The combination of low barriers to imitation and many capable competitors makes rapid imitation almost certain. The innovator's lack of complementary assets further suggests that an imitator will soon capture the innovator's competitive advantage. Given these factors, and because rapid diffusion of the innovator's technology through imitation is inevitable, the innovator can at least share in some of the benefits of this diffusion by licensing its technology.[23] Moreover, by setting a relatively modest licensing fee, the innovator may be able to reduce the incentive that potential rivals have to develop their own competing, and possibly superior, technology. This seems to have been the strategy Dolby adopted to get its technology established as the standard for noise reduction in the music and film businesses (see Strategy in Action 7.1).

Technological Paradigm Shifts

Technological paradigm shifts occur when new technologies come along that revolutionize the structure of the industry, dramatically alter the nature of competition, and require companies to adopt new strategies to survive. A good example of a paradigm shift that is currently unfolding is the shift from chemical to digital photography (another example of digitalization). For over half a century, the large incumbent enterprises in the photographic industry such as Kodak and Fuji film have generated most of their revenues from selling and processing film using traditional silver halide technology. The rise of digital photography is a huge threat to their business models. Digital cameras do not use film, the mainstay of Kodak's and Fuji's business. Moreover, these cameras are more like specialized computers than conventional cameras and are thus based on scientific knowledge that Kodak and Fuji have little knowledge of. Although both Kodak and Fuji are investing heavily in the development of digital cameras, they are facing intense competition from companies such as Sony, Canon, and Hewlett-Packard, which have developed their own digital cameras; from software developers such as Adobe and Microsoft, which make the software for manipulating digital images; and from printer companies such as Hewlett-Packard and Canon, which are making the printers that consumers can use to print out their own high-quality pictures at home. As digital substitution gathers speed in the photography industry, it is not clear that the traditional incumbents will be able to survive this shift; the new competitors might well rise to dominance in the new market.

If Kodak and Fuji do decline, they will not be the first large incumbents to be felled by a technological paradigm shift in their industry. In the early 1980s, the computer industry was revolutionized by the arrival of personal computer technology, which gave rise to client-server networks that replaced traditional mainframe and minicomputers for many business uses. Many incumbent companies in the mainframe era, such as Wang, Control Data, and DEC, ultimately did not survive, and even IBM went through a decade of wrenching changes and large losses before it reinvented itself as a provider of ebusiness solutions. In their place, new entrants such as Microsoft, Intel, Dell, and Compaq rose to dominance in this new computer industry.

Examples such as these raise four questions:

1. When do paradigm shifts occur, and how do they unfold?
2. Why do so many incumbents go into decline following a paradigm shift?
3. What strategies can incumbents adopt to increase the probability that they will survive a paradigm shift as profitable enterprises and emerge on the other side of the market abyss created by the arrival of new technology?
4. What strategies can new entrants into a market adopt to profit from a paradigm shift?

We shall answer each of these questions in the remainder of this chapter.

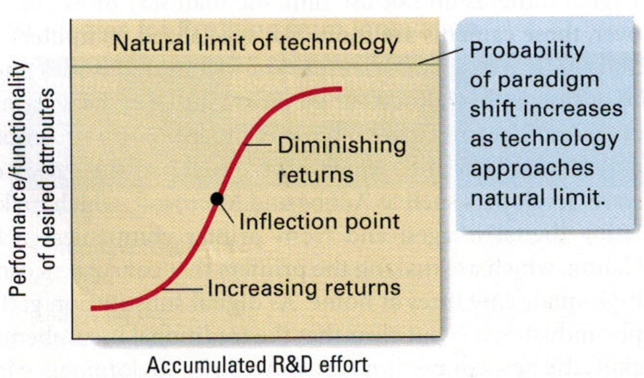
Paradigm Shifts and the Decline of Established Companies

Paradigm shifts appear to be more likely to occur in an industry when one or both of the following conditions are in place: First, the established technology in the industry is mature and approaching or at its "natural limit," and second, a new "disruptive technology" has entered the marketplace and is taking root in niches that are poorly served by incumbent companies using the established technology.[24]

The Natural Limits to Technology Richard Foster has formalized the relationship between the performance of a technology and time in terms of what he calls the technology S-curve (see Figure 7.5).[25] This curve shows the relationship over time of cumulative investments in R&D and the performance (or functionality) of a given technology. Early in the evolution of a new technology, R&D investments in a new technology tend to yield rapid improvements in performance as basic engineering problems are solved. After a time, diminishing returns to cumulative R&D begin to set in, the rate of improvement in performance slows, and the technology starts to approach its natural limit, where further advances are not possible. For example, one can argue that there was more improvement in the first fifty years of the commercial

FIGURE 7.5

The Technology S-Curve



aerospace business following the pioneering flight by the Wright Brothers than there has been in the second fifty years. Indeed, the world's largest commercial jet aircraft, the Boeing 747, is based on a 1960s design, as is the world's fastest commercial jet aircraft, the Concorde. In commercial aerospace, therefore, we are now in the region of diminishing returns and may be approaching the natural limit to improvements in the technology of commercial aerospace.

Similarly, it can be argued that we are approaching the natural limit to technology in the performance of silicon-based semiconductor chips. Over the past two decades, the performance of semiconductor chips has been increased dramatically by packing ever more transistors onto a single small silicon chip. This process has helped to increase the power of computers, lower their cost, and shrink their size. But we are starting to approach limits to the ability to shrink the width of lines on a chip and therefore pack ever more transistors onto a single chip. The limit is imposed by the natural laws of physics. Light waves are used to help etch lines onto a chip, and one cannot etch a line that is smaller than the wavelength of light being used. Semiconductor companies are already using light with very small wavelengths, such as extreme ultraviolet, to etch lines onto a chip, but there are limits to how far this technology can be pushed, and many believe that we will reach those limits within the decade. Does this mean that our ability to make smaller, faster, cheaper computers is coming to an end? Probably not. It is more likely that we will find another technology to replace silicon-based computing and enable us to continue building smaller, faster, cheaper computers. In fact, several exotic competing technologies are already being developed that may replace silicon-based computing. These include self-organizing molecular computers, three-dimensional microprocessor technology, quantum computing technology, and the use of DNA to perform computations.[26]

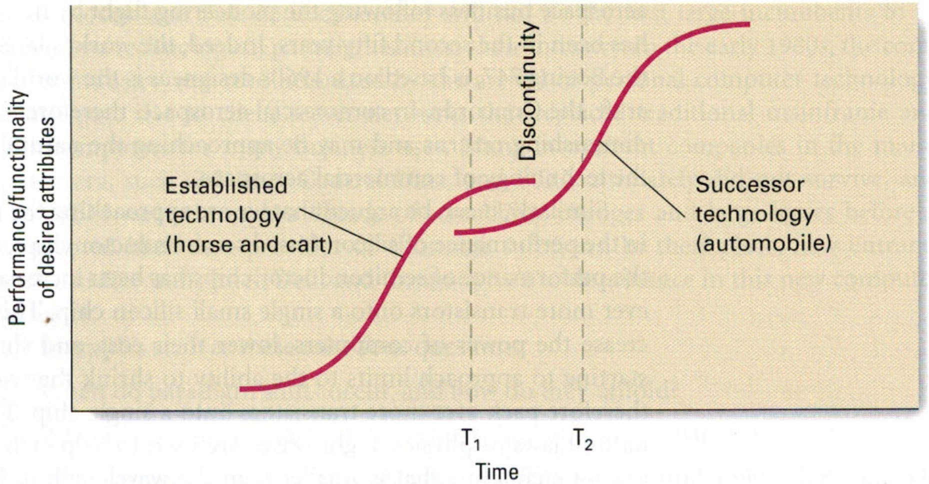
What does all of this have to do with paradigm shifts? According to Foster, when a technology approaches its natural limit, research attention turns to possible alternative technologies, and sooner or later one of those alternatives might be commercialized and replace the established technology. That is, the probability that a paradigm shift will occur increases. Thus, sometime in the next decade or two, another paradigm shift might shake the very foundations of the computer industry as exotic computing technology replaces silicon-based computing. If and when this happens, and if history is any guide, many of the incumbents in today's computer industry will go into decline, and new enterprises will rise to dominance.

Foster pushes this point a little further, noting that, initially, the contenders for the replacement technology are not as effective as the established technology in producing the attributes and features that consumers demand in a product. For example, in the early years of the twentieth century, automobiles were just starting to be produced. They were valued for their ability to move people from place to place, but so were the horse and cart (the established technology). When automobiles originally appeared, the horse and cart were still quite a bit better than the automobile at moving people from place to place (see Figure 7.6). After all, the first cars were slow, noisy, and likely to break down. Moreover, they needed a network of paved roads and gas stations to be really useful, and that network didn't exist, so for most applications, the horse and cart were still the preferred mode of transportation—to say nothing of the fact that they were cheaper.

However, this comparison ignored the fact that in the early twentieth century, automobile technology was at the very start of its S-curve and was about to experience dramatic improvements in performance as major engineering problems were solved (and those paved roads and gas stations were built). In contrast, after 3,000 years of

FIGURE 7.6

Established and Successor Technologies



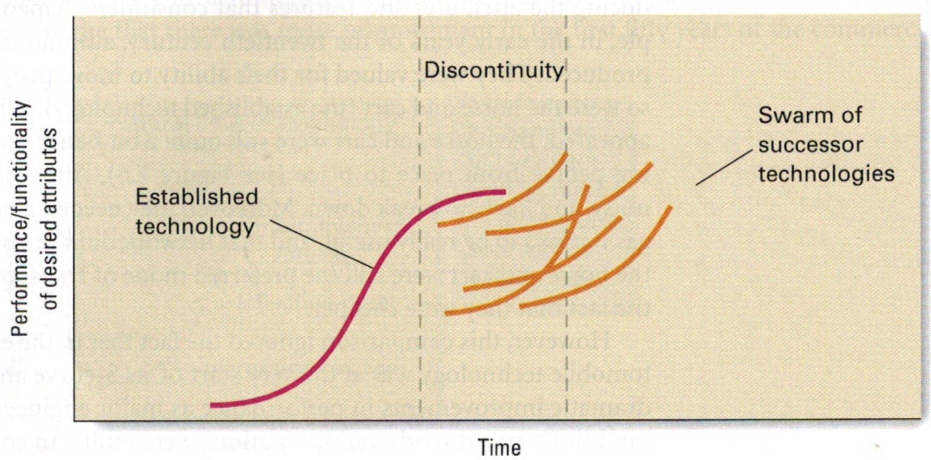
continuous improvement and refinement, the horse and cart were almost definitely at the end of their technological S-curve. The result was that the rapidly improving automobile soon replaced the horse and cart as the preferred mode of transportation. At time T1 in Figure 7.6, the horse and cart were still superior to the automobile. By time T2, the automobile had surpassed the horse and cart.

Foster notes that because the successor technology is initially less efficient than the established technology, established companies and their customers often make the mistake of dismissing it, only to be taken off-guard by its rapid performance improvement. A final point is that more than one potential successor technology appears, usually a swarm of potential successor technologies, only one of which might ultimately come to the fore (see Figure 7.7). When this is the case, established companies are put at a disadvantage. Even if they recognize that a paradigm shift is imminent, they may not have the resources to invest in all the potential replacement technologies. If they invest in the wrong one (something that is easy to do given the uncertainty that surrounds the entire process), they may be locked out of subsequent development.

Disruptive Technology Clayton Christensen has built on Foster's insights and his own research to develop a theory of disruptive technology that has become very

FIGURE 7.7

Swarm of Successor Technologies



influential in high-technology circles.[27] Christensen uses the term *disruptive technology* to refer to a new technology that gets its start away from the mainstream of a market and then, as its functionality improves over time, invades the main market. Such technologies are disruptive because they revolutionize industry structure and competition, often causing the decline of established companies. They cause a technological paradigm shift.

Christensen's greatest insight is that established companies are often aware of the new technology but do not invest in it because they listen to their customers, and their customers do not want it. Of course, this arises because the new technology is early in its development, and thus only at the beginning of the S-curve for that technology. Once the performance of the new technology improves, customers do want it, but by this time, new entrants, as opposed to established companies, have accumulated the knowledge required to bring the new technology into the mass market. Christensen supports his view with several detailed historical case studies, one of which is summarized in Strategy in Action 7.4.

Strategy in Action 7.4

Disruptive Technology in Mechanical Excavators

Excavators are used to dig foundations for large buildings, trenches to lay large pipes for sewers and the like, and foundations and trenches for residential construction and farm work. Prior to the 1940s, the dominant technology used to manipulate the bucket on a mechanical excavator was based on a system of cables and pulleys. Although these mechanical systems could lift large buckets of earth, the excavators themselves were quite large, cumbersome, and expensive. Thus, they were rarely used to dig small trenches for house foundations, irrigation ditches for farmers, and the like. In most cases, these small trenches were dug by hand.

In the 1940s, a new technology made its appearance: hydraulics. In theory, hydraulic systems had certain advantages over the established cable and pulley systems. Most important, their energy efficiency was higher: for a given bucket size, a smaller engine would be required for a hydraulic system. However, the initial hydraulic systems also had drawbacks. The seals on hydraulic cylinders were prone to leaking under high pressure, effectively limiting the size of the bucket that could be lifted using hydraulics. Notwithstanding this drawback, when hydraulics first appeared, many of the incumbent firms in the mechanical excavation industry took the technology seriously enough to ask their primary customers whether they would be interested in products based on hydraulics. Because the primary customers of incumbents needed excavators with large buckets to dig out the foundations for buildings and large trenches, their reply was no. For this customer set, the hydraulic systems of the 1940s were not reliable or powerful enough. Consequently, after consulting with their customers, the established companies in the industry made the strategic decision not to invest in hydraulics. Instead, they continued to produce excavation equipment based on the dominant cable and pulley technology.

It was left to a number of new entrants, which included J. I. Case, John Deere, J. C. Bamford, and Caterpillar, to pioneer hydraulic excavation equipment. Because of the limits on bucket size imposed by the seal problem, these companies initially focused on a poorly served niche in the market that could make use of small buckets: residential contractors and farmers. Over time, these new entrants were able to solve the engineering problems associated with weak hydraulic seals, and as they did so, they manufactured excavators with larger buckets. Ultimately, they invaded the market niches served by the old-line companies: general contractors that dug the foundations for large buildings, sewers, and so on. At this point, Case, Deere, Caterpillar, and their kin rose to dominance in the industry, while the majority of established companies from the prior era lost share. Of the thirty or so manufacturers of cable-actuated equipment in the United States in the late 1930s, only four survived to the 1950s.[d]

In addition to listening too closely to their customers, Christensen also identifies a number of other factors that make it very difficult for established companies to adopt a new disruptive technology. He notes that many established companies declined to invest in new disruptive technologies because initially they served such small market niches that it seemed unlikely that they would have an impact on the company's revenues and profits. As the new technology started to improve in functionality and invade the main market, their investment was often hindered by the fact that exploiting the new technology required a new business model totally different from the company's established model, and thus was very difficult to implement.

Both of these points can be illustrated by referring to one more example: the rise of online discount stockbrokers, such as Ameritrade and E*Trade, which made use of a new technology, the Internet, during the 1990s to allow individual investors to trade stocks for a very low commission fee. In contrast, full-service stockbrokers, such as Merrill Lynch, where orders had to be placed through a stockbroker who earned a commission for performing the transaction, did not.

Christensen also notes that a new network of suppliers and distributors typically grows up around the new entrants. Not only do established companies initially ignore disruptive technology, but so do their suppliers and distributors. This creates an opportunity for new suppliers and distributors to enter the market to serve the new entrants. As the new entrants grow, so does the associated network. Ultimately, Christensen suggests, the new entrants and their network may replace not only established enterprises, but also the entire network of suppliers and distributors associated with established companies. Taken to its logical extreme, this view suggests that disruptive technologies may result in the demise of the entire network of enterprises associated with established companies in an industry.

The established companies in an industry that is being rocked by a technological paradigm shift often have to cope with internal inertia forces that limit their ability to adapt, but the new entrants do not and thereby have an advantage. They do not have to deal with an established and conservative customer set and an obsolete business model. Instead, they can focus on optimizing the new technology, improving its performance, and riding the wave of disruptive technology into new market segments until they invade the main market and challenge the established companies, by which time they may be well equipped to beat them.

Strategic Implications for Established Companies

Although Christensen has uncovered an important tendency, it is by no means written in stone that all established companies are doomed to fail when faced with disruptive technologies, as we have seen with IBM and Merrill Lynch. Established companies must meet the challenges created by the emergence of disruptive technologies.[28]

First, having access to the knowledge about how disruptive technologies can revolutionize markets is itself a valuable strategic asset. Many of the established companies that Christensen examined failed because they took a myopic view of the new technology and asked their customers the wrong question. Instead of asking, "Are you interested in this new technology?" they should have recognized that the new technology was likely to improve rapidly over time and instead asked, "Would you be interested in this new technology if it improves its functionality over time?" If they had done so, they may have made very different strategic decisions.

Second, it is clearly important for established enterprises to invest in newly emerging technologies that may ultimately become disruptive technologies. Companies have to hedge their bets about new technology. As we have noted, at any time, there may be a swarm of emerging technologies, any one of which might ultimately become a disruptive technology. Large, established companies that are generating significant cash flows can and often should establish and fund central R&D operations to invest in and develop such technologies. In addition, they may wish to acquire newly emerging companies that are pioneering potentially disruptive technologies or enter into alliances with them to develop the technology jointly. The strategy of acquiring companies that are developing potentially disruptive technology is one that Cisco Systems, a dominant provider of Internet network equipment, is famous for pursuing. At the heart of this strategy must be recognition on the part of the incumbent enterprise that it is better for the company to develop disruptive technology and then cannibalize its established sales base than to have that sales base taken away by new entrants.

However, Christensen makes the very important point that even when established companies do undertake R&D investments in potentially disruptive technologies, they often fail to commercialize those technologies because of internal forces that suppress change. For example, managers in the parts of the business that are currently generating the most cash may claim that they need the greatest R&D investment to maintain their market position and may lobby top management to delay investment in a new technology. Early in the S-curve, when it is very unclear what the long-term prospects of a new technology may be, this can be a powerful argument. The consequence, however, may be that the company fails to build a competence in the new technology and will suffer accordingly.

In addition, Christensen argues that the commercialization of new disruptive technology often requires a radically different value chain with a completely different cost structure—a new business model. For example, it may require a different manufacturing system, a different distribution system, and different pricing options and involve very different gross margins and operating margins. Christensen argues that it is almost impossible for two distinct business models to coexist within the same organization. When they try to do that, almost inevitably the established business model will suffocate the business model associated with the disruptive technology.

The solution to this problem is to separate the disruptive technology and place it in its own autonomous operating division. For example, during the early 1980s, Hewlett-Packard (HP) built a very successful laser printer business. Then along came inkjet technology. Some in the company believed that inkjet printers would cannibalize sales of laser printers and consequently argued that HP should not produce inkjet printers. Fortunately for HP, senior management at the time saw inkjet technology for what it was: a potential disruptive technology. Instead, they allocated significant R&D funds toward its commercialization. Furthermore, when the technology was ready for market introduction, they established an autonomous inkjet division at a different geographic location with its own manufacturing, marketing, and distribution activities. They accepted that the inkjet division might take sales away from the laser printer division and decided that it was better to have an HP division cannibalize the sales of another HP division than have those sales cannibalized by another company. Luckily for HP, it turns out that inkjet printers cannibalize sales of laser printers only on the margin and that both have profitable market niches. This outcome, however, does not detract from the message of the story: if your company is developing a potentially disruptive technology, the chances of success will be enhanced if it is placed in a stand-alone product division and given its own mandate.

Strategic Implications for New Entrants

This work just discussed also holds implications for new entrants. The new entrants, or attackers, have several advantages over established enterprises. Pressures to continue the existing out-of-date business model do not hamstring new entrants, which do not have to worry about product cannibalization issues. They do not have to worry about their established customer base or relationships with established suppliers and distributors. Instead, they can focus all their energies on the opportunities offered by the new disruptive technology, ride the S-curve of technology improvement, and grow rapidly with the market for that technology. This does not mean that the new entrants have no problems to solve. They may be constrained by a lack of capital or have to manage the organizational problems associated with rapid growth; most importantly, they may need to find a way to take their technology from a small out-of-the-way niche into the mass market.

Perhaps one of the most important issues facing new entrants is the choice of whether to partner with an established company or go it alone in their attempt to develop and profit from a new disruptive technology. Although a new entrant may enjoy all of the advantages of the attacker, it may lack the resources required to exploit them fully. In such a case, it might want to consider forming a strategic alliance with a larger, established company to gain access to those resources. The main issues here are the same as those that we discussed earlier when examining the three strategies that companies can pursue to capture first-mover advantages: go it alone, enter into a strategic alliance, or license the technology.

Summary of Chapter

1. Technical standards are important in many high-tech industries: they guarantee compatibility, reduce confusion in the minds of customers, allow for mass production and lower costs, and reduce the risks associated with supplying complementary products.
2. Network effects and positive feedback loops often determine which standard comes to dominate a market.
3. Owning a standard can be a source of sustained competitive advantage.
4. Establishing a proprietary standard as the industry standard may require the company to win a format war against a competing and incompatible standard. Strategies for doing this include producing complementary products, leveraging killer applications, using aggressive pricing and marketing, licensing the technology, and cooperating with competitors.
5. Many high-tech products are characterized by high fixed costs of development but very low or zero marginal costs of producing one extra unit of output. These cost economics create a presumption in favor of strategies that emphasize aggressive pricing to increase volume and drive down average total costs.
6. Many digital products suffer from very high piracy rates because of the low marginal costs of copying and distributing such products. Piracy can be reduced by the appropriate combination of strategy, encryption software, and vigorous defense of intellectual property rights.
7. It is very important for a first mover to develop a strategy to capitalize on first-mover advantages. A company can choose from three strategies: develop and market the technology itself, do so jointly with another company, or license the technology to existing companies. The choice depends on the complementary assets required to capture a first-mover advantage, the height of barriers to imitation, and the capability of competitors.
8. Technological paradigm shifts occur when new technologies come along that revolutionize the structure of the industry, dramatically alter the nature of competition, and require companies to adopt new strategies to survive.
9. Technological paradigm shifts are more likely to occur when progress in improving the established technology is slowing because it is giving diminishing returns and a new disruptive technology is taking root in a market niche.
10. Established companies can deal with paradigm shifts by hedging their bets with regard to technology or setting up a stand-alone division to exploit the technology.

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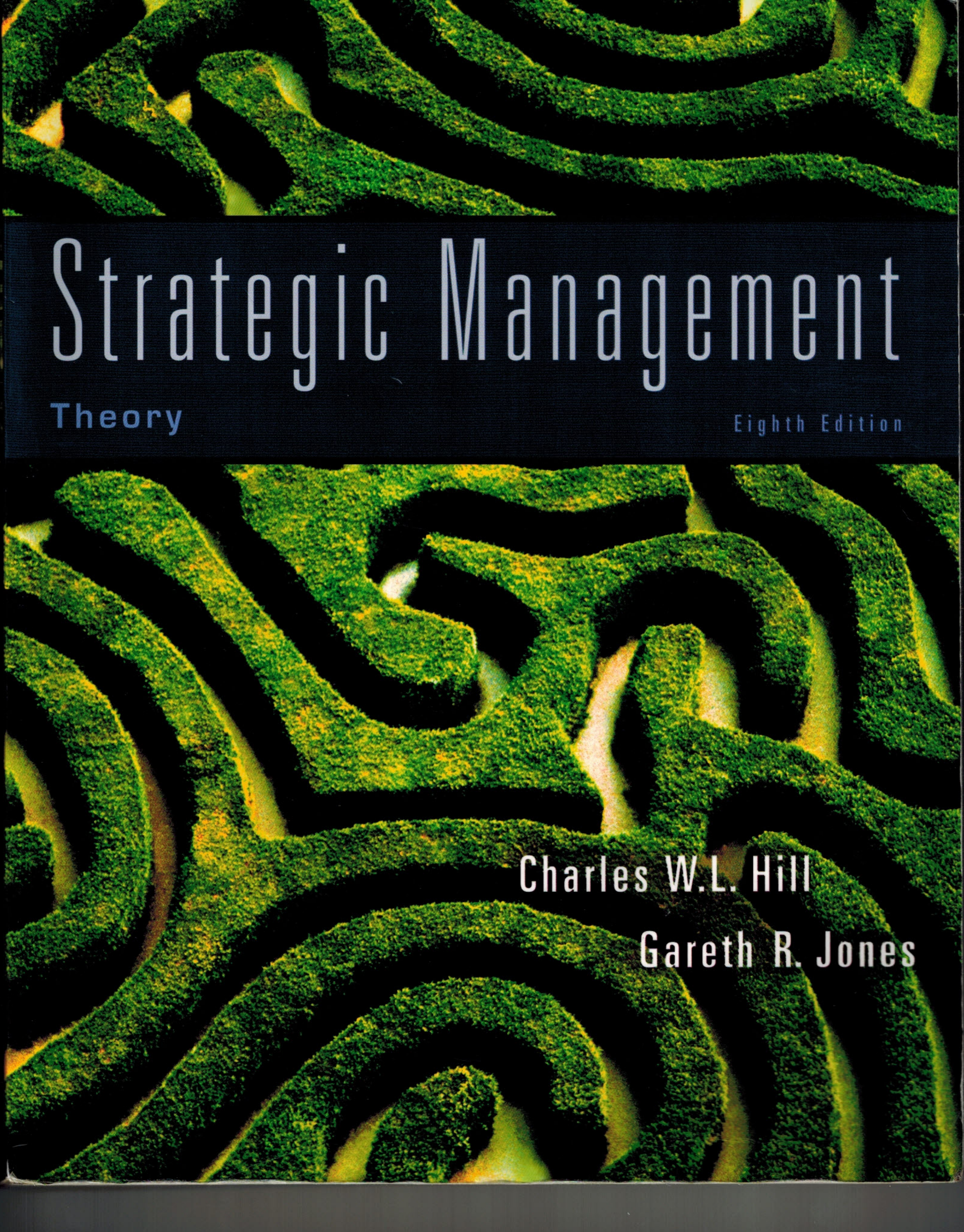

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