Chapter **Nine**

Protecting Innovation

The Digital Music Distribution Revolution[a]

Fraunhofer and MP3

In 1991, Fraunhofer IIS of Germany developed an algorithm that would set in motion a revolution in how music was distributed, stored, and consumed. The algorithm (commonly referred to as a codec) allowed compression of digital audio to approximately one-tenth of its original size with minimal compromise in audible quality. The format also enabled song information such as the song title and artist to be embedded within the file. This format for compressed audio files was later dubbed MPEG-1 layer 3—a.k.a. MP3. By 1995, software programs were available that enabled consumers to convert tracks from compact discs to MP3 files. This technology transformed how music could be manipulated—a song was now a file that could be kept on a hard drive, and the file was small enough to be shared over the Internet. The MP3 format became wildly popular by users sharing their music online, and software companies began releasing many variants of MP3 encoders (utilities that compress files into MP3s) and decoders (utilities that play back MP3s). Hardware manufacturers decided to capitalize on this new trend and several hardware MP3 players began appearing on the market.

With the growing popularity of the file format, Fraunhofer was faced with a dilemma—should it enforce its patent on the use of the MP3 algorithm and attempt to collect royalties for its use, or should it allow users and software/hardware manufacturers to make free use of the algorithm, allowing the momentum of the format to build? If it was to limit the use of the algorithm, it faced the risk of established rivals such as Microsoft and Sony developing competing formats, yet if it allowed free use of the algorithm, it would be difficult to profit on its invention.

Fraunhofer decided to pursue a partially open licensing approach, partnering with Thomson Multimedia as the exclusive licensing representative of MP3 patents in 1995.[b] Thomson, in turn, negotiated agreements with several companies including Apple, Adobe, Creative Labs, Microsoft, and many others. Such a broad base of MP3 licensees (100 by April 2001) provided consumers with easy access to encoders, decoders, and the format in general. Licensees generally

opted to provide decoders free of charge, while charging a nominal fee to those who wished to encode MP3s.

Fraunhofer continued to innovate, introducing the mp3PRO format and working on the Advanced Audio Coding (AAC) format with Dolby that Apple would later use. Many other companies also developed or adapted their own audio compression codecs including Sony (ATRAC codec, originally developed in 1991 for use with Mini Discs[c]) and Microsoft (WMA, launched in April 1999[d]). However, by 1996, MP3s could be found on computers worldwide, and it appeared that MP3 had won the battle for dominant design in compressed audio formats.

Napster Takes the Lead

In 1999, while a student at Northeastern University in Boston, Shawn Fanning released Napster—a software program that allowed users with Internet access to easily share MP3 files. Napster provided a user-friendly solution to music fans wishing to share and find music online. Napster provided a user interface with a search box that pointed individuals to other users with the files they wished to download. The Napster servers did not host any MP3 files; rather they hosted a database with information on which users had which files to share and whether they were online, and connected one computer to another for downloading. Napster was one of the first widely adopted "peer-to-peer" applications, and helped popularize the term.

Napster was free, and as the growing number of people with Internet access realized, so was the music that it allowed them to access. Users were increasingly trading copyrighted material—commercial records and songs. In fact, the great majority of music downloaded through Napster was copyrighted material. By March 2000, 5 million copies of Napster had already been downloaded.[e] At its peak, there were 70 million Napster users.[f]

While "music pirates" around the world embraced Napster, the Recording Industry Association of America (RIAA), the trade group that represents the leading music business entities in the United States, grew increasingly alarmed. The RIAA worried that the growing illegal trade of music would result in a loss of profits for its constituents—record labels that owned the rights to much of the popular commercial music that was being traded online. The RIAA initiated legal action against Napster and Napster users in an effort to take the service offline and curtail illegal file sharing. This move was controversial for several reasons. Some analysts believed that it would be difficult to fight a technological advance such as this by legal action alone, and that the RIAA would not be successful unless it offered a legitimate alternative for users who wished to purchase music online. Other analysts took an even stronger stance, arguing that the record labels were not only fighting to protect the rights of artists, but to protect a business model that had become outdated.[g] They argued that the popularity of Napster was partially due to the rigid and overpriced traditional music distribution model, where fans were forced to buy albums for prices that some felt were inflated, and did not have the choice to buy individual songs. This was not the first time the entertainment industry had resisted a change in business models and was reluctant to embrace a new technology. A 2001 article in *The Economist* pointed out that "Phonographs were going to kill sheet music, the rise of radio threatened to

undermine sales of phonograph discs, video recorders were going to wipe out the film industry, and cassette recorders spelt doom for the music business. . . . In each case, their fears proved unfounded. The new technologies expanded the markets in unprecedented ways."[h] Some commentators believed that the new technology could be beneficial for the recording industry. If harnessed appropriately, it could enable an inexpensive distribution method, as well as direct intimate interaction with consumers that allowed for targeted marketing.

In 2001, Napster offered the RIAA a partnership that included a legitimate digital distribution model that would make online music available via a subscription service. The RIAA declined, and instead continued to pursue a legal judgment against Napster. In July 2001, the court ruled in the RIAA's favor, and the Napster service was taken offline. It was a blow to peer-to-peer fans worldwide.

Though the record labels had won the battle against Napster, they began to realize the war was far from over. Services similar to Napster began to sprout up online, offering "users in the know" the opportunity to continue pirating music. The record labels continued to pursue legal action against peer-to-peer services and users who engaged in illegal file trading, while coming to terms with the need to offer a legitimate alternative service. Subsequently, Warner Music teamed up with BMG, EMI, and RealNetworks to introduce MusicNet, and Sony Entertainment and Universal created Pressplay, both of which were subscription services that enabled individuals to download music legally from the Web. However, in an attempt to control their music catalogs, the labels used proprietary file formats and severely limiting digital rights management (DRM) schemes that confused users. Furthermore, neither service offered the breadth of selection offered by unauthorized peer-to-peer services such Kazaa or Gnutella. The popularity of peer-to-peer music swapping continued to grow. The RIAA needed a savior. Steve Jobs offered to be that guy.

iTunes Just in Time

On April 28, 2003, Apple opened its iTunes Music Store. After striking agreements with the five major record labels (Sony, Universal, BMG, Warner Music Group, and EMI), iTunes launched with an initial catalogs of 200,000 songs for purchase at 99 cents per song.[i] iTunes showed immediate signs of success, boasting 50 million downloads within the first year, and quickly became the leading distributor of music online.[j] Apple got the blessing of the recording industry after guaranteeing them that the files offered via the Music Store would allow for protection against illegal sharing thanks to the "FairPlay" DRM scheme. In essence, the iTunes Music Store offered audio in two file formats—Advanced Audio Coding (AAC) and modified MP3s. With Apple's Fairplay DRM, song files could be loaded on up to five computers only, and could not be played on non-iPod MP3 players. In addition, the files could not be e-mailed or distributed over the Web, and files were "hidden" on the iPod through a subdirectory structure that made it difficult to copy songs from a friend's iPod. All of these features helped to prevent users from mass-distributing songs to others, helping to ease the minds of record company executives.

The success of iTunes was fueled by a number of factors. The company had a "cool" image that was attractive to the recording industry and users alike.

The company also used the familiar MP3 format, offered an attractive price tag for online music, and its licensing agreements with all five major labels enabled it to offer a one-stop source for customers. In addition, the FairPlay DRM was not as restrictive as other competing formats,[k] and this was important to many users. The success of iTunes was also accelerated by the success of Apple's iPods. iPods are hard-disk–based portable MP3 players that are well designed, well marketed, and user-friendly. Though there had been some criticisms concerning their dependability (chiefly related to battery life)[l] and sound quality issues,[m] casual music consumers took to these players in large numbers. To the appreciation of the RIAA, the iPods required synchronization with one's music collection via the iTunes application, thereby making it difficult to share music stored on the iPod, or purchased from iTunes.

The recording industry had found a new channel of distribution that earned significant revenues (about $0.70 of every $0.99 sale on iTunes is delivered directly to the record labels[n]), and Apple had licensing agreements with all the major labels, which afforded Apple access to huge catalogs. Apple leveraged these catalogs to entice users to buy music through its iTunes Music Store, and this in turn helped drive sales of the Apple iPod, since files bought on iTunes could not be played on rival MP3 players. Apple was well positioned, but threats loomed on the horizon.

In March 2006, the French National Assembly approved a bill requiring Apple to open its FairPlay DRM technology to industry rivals in France.[o] This meant that Apple would have to allow songs downloaded from the French iTunes Music Store to be played on non-iPod MP3 players, and that iPods would need to play competing file formats, such as Sony's ATRAC3 files purchased through the Sony Connect online music store. Many users could appreciate this interoperability, yet it would challenge the "single operator license model" that had eased the minds of the recording industry and created a large and loyal customer base for Apple. Initially analysts speculated that Apple would withdraw from the French market, but instead Apple began working on negotiating fewer DRM restrictions from the record labels. By March of 2009, Apple had convinced all the major labels to permit their songs to be sold through iTunes without DRM. In return, Apple adopted the tiered pricing model that the major labels had long requested.

The rise of smartphones that could hold users' music digital libraries in addition to offering a host of other useful functions helped to fuel the growth of digital music sales. By 2011, digital music sales exceeded physical sales in both the United States and South Korea, and by 2016 digital music sales exceeded physical music sales in roughly half of the major music markets of the world.[p] However, an even bigger transition was also changing the landscape of music. Rapidly growing services such as Spotify, Pandora, and Apple Music were now streaming music over the Internet, enabling listeners to hear whatever music they wanted, whenever they wanted, on a wide range of devices, without the user ever taking ownership of the music. Though many had feared that a transition to streaming would be disastrous to the recorded music industry, instead paid music streaming subscriptions fueled record-setting market growth. In 2016, the global recorded music market grew by almost 6 percent—the highest rate since 1997—to a total of US$15.7 billion.

Discussion Questions

1. What industry conditions led to the revolution in audio distribution described above? Which stakeholders stand to benefit most (or least) from this revolution?
2. Why did the music stores created by the record labels fail to attract many subscribers? What, if anything, should the record labels have done differently?
3. What factors led iTunes to be successful?
4. How do you think a move away from owning music led to record-setting music revenues?

[a] Adapted from a New York University teaching case by Shachar Gilad, Christopher Preston, and Melissa A. Schilling.
[b] "Thomson Multimedia Signs 100th mp3 Licensee," press release (PR Newswire), April 18, 2001.
[c] Junko Yoshida, "Sony Sounds Off about Mini Disc," *Electronic World News,* no. 41 (June 3, 1991), p.15.
[d] Jack Schofield, "Music Definitions," *The Guardian,* October 5, 2000, p. 3.
[e] Karl Taro Greenfeld, "The Free Juke Box: College Kids Are Using New, Simple Software Like Napster to Help Themselves to Pirated Music," *Time,* March 27, 2000, p. 82.
[f] Michael Gowan, "Easy as MP3," *PC World* 19, no. 11 (November 2001), p. 110.
[g] "The Same Old Song," *The Economist* 358, no. 8210 (January 24, 2002), pp. 19, 20.
[h] Ibid.
[i] Michael Amicone, "Apple Took a Big Bite Out of the Market," *Billboard* 116, no. 16 (April 17, 2004), p. 2.
[j] "iTunes Music Store Downloads Top 50 Million Songs," press release, March 15, 2004.
[k] Ibid.
[l] "Apple Faces Class Action Suits on iPod Battery," *Reuters,* February 10, 2004.
[m] Randall Stross, "From a High-Tech System, Low-Fi Music," *New York Times,* July 4, 2004, p. 3.
[n] Alex Veiga, "Recording Labels, Apple Split over Pricing," *Associated Press,* April 2, 2006.
[o] Rob Pegoraro, "France Takes a Shot at iTunes," *WashingtonPost.com*, March 26, 2006, p. F06.
[p] International Federation of the Phonographic Industry Global Music Report 2017.

OVERVIEW

A crucial element of formulating a firm's technological innovation strategy is determining whether and how to protect its technological innovation. Traditionally, economics and strategy have emphasized the importance of vigorously protecting an innovation in order to be the primary beneficiary of the innovation's rewards, but the decision about whether and to what degree to protect an innovation is actually complex. Sometimes *not* vigorously protecting a technology is to the firm's advantage—encouraging other producers (and complementary goods providers) to support the technology may increase its rate of diffusion and its likelihood of rising to the position of dominant design. In this chapter, we first will review the factors that shape the degree to which a firm is likely to appropriate the returns from its innovation, and the mechanisms available to the firm to protect its innovation. We then will consider the continuum between a wholly proprietary strategy and a wholly open strategy, examining the trade-offs inherent in decisions about whether (and to what degree) to protect or diffuse a technological innovation. The chapter concludes by listing factors the firm should consider in formulating its protection strategy.

APPROPRIABILITY

appropriability
The degree to which a firm is able to capture the rents from its innovation.

The degree to which a firm can capture the rents from its innovation is termed **appropriability**. In general, the appropriability of an innovation is determined by how easily or quickly competitors can imitate the innovation. The ease with which competitors can imitate the innovation is, in turn, a function of both the nature of the technology itself and the strength of the mechanisms used to protect the innovation.

tacit knowledge
Knowledge that cannot be readily codified or transferred in written form.

socially complex knowledge
Knowledge that arises from the interaction of multiple individuals.

Some technological innovations are inherently difficult for competitors to copy; the knowledge underlying the technology may be rare and difficult to replicate. A firm's unique prior experience or talent pool may give it a foundation of technical know-how that its competitors do not possess. If this knowledge base is **tacit** (i.e., it cannot be readily codified into documents or procedures) or **socially complex** (i.e., it arises through complex interactions between people), competitors will typically find it very difficult to duplicate.[1] For example, a firm that has a team of uniquely talented research scientists may have a rare and difficult-to-imitate knowledge base. While some of the skill of the research scientists may be due to imitable training procedures, *talent* typically implies that an individual (or group) has a natural endowment or ability that is very difficult, if not impossible, to replicate through training. Furthermore, if the unique capabilities of the research team arise in part from the nature of the interactions between the scientists, their performance will be socially complex. Interactions between individuals can significantly shape what each individual perceives, and thus what each individual—and the collective group—discovers or learns. The outcomes of these interactions are path dependent, and thus are idiosyncratic to the combination of individuals, the moment of the interaction, and the nature of the interaction. This means that knowledge can emerge from the interaction of a group that could not be replicated by any individual or any different group.

Many innovations, however, are relatively easy for competitors to imitate. Individuals and firms often employ legal mechanisms to attempt to protect their innovations. Most countries offer legal protection for intellectual property in the form of patent, trademark, copyright, and trade secret laws.

PATENTS, TRADEMARKS, AND COPYRIGHTS

patent
A property right protecting a process, machine, manufactured item (or design for manufactured item), or variety of plant.

trademark
An indicator used to distinguish the source of a good.

While patents, copyrights, and trademarks are all ways of protecting intellectual property, they are each designed to protect different things. A **patent** protects an invention, and a **trademark** protects words or symbols intended to distinguish the source of a good. A **copyright** protects an original artistic or literary work. Thus, a typical computer might have components whose designs are protected by patents, logos such as the Starbuck's mermaid that are protected by trademark law, and software that is protected by copyright (though as discussed later in the section on patents, many types of software are now also eligible for patent protection).

The purpose of intellectual property protection is to provide recognition and incentive for creative work. Patents and copyrights, for example, provide a legal means for individuals to protect their creative work and earn rewards from it, in exchange for making the knowledge underlying their work public. Making this knowledge public is important because it helps others to build upon that knowledge, driving technological

copyright
A property right protecting works of authorship.

and social advance. In absence of those protections, people might prefer to keep their discoveries and inventions secret.

Patents

In many countries, inventors can apply for patent protection for their inventions. An invention can be a product, such as a new type of battery, or a process, such as a new way to manufacture bagels. In the United States, patents are categorized into different types such as a *utility* patent for a new and useful process, machine, manufactured item, or combination of materials; a *design* patent for an original and ornamental design for a manufactured item; or a *plant* patent for the discovery and asexual reproduction of a distinct and new variety of plant.

Each country has its own patent system with different requirements, and unless a patent is filed under a regional patent office or an international treaty, the rights it is granted are applicable only in the country in which the patent is filed.

To qualify for a patent, an invention must usually meet the following criteria:

1. It must be *useful* (i.e., it must produce a desirable result, solve a problem, improve on or propose a new use for an existing development or show potential of doing so).
2. It must be *novel* (i.e., it must not already be patented or described in public literature, or be in public use for more than a year).
3. It must *not be obvious* (i.e., a person with experience or skill in the particular art of the patent would not be expected to achieve the same invention with a normal amount of effort).

In most countries, the discovery of scientific principles that pertain to natural laws (e.g., gravity) cannot be patented because they are considered to have always existed. Additionally, the following are not typically patentable:

- Substituting one material for another (e.g., plastic for metal).
- Merely changing the size of an already existing device.
- Making something more portable.
- Substituting an element for an equivalent element.
- Altering an item's shape.

Printed materials are not typically patentable, but it may be possible to protect them by copyright, as discussed in the next section. Historically software algorithms were not considered patentable, but in 1998, a U.S. Supreme Court case upheld a patent on a computerized method of managing mutual funds that relied on software algorithms, unleashing a flood of patent applications for software. From 1997 to 2000, patent filings in the United States for software-enabled methods of doing business increased more than 700 percent.[2] For example, Amazon patented its "1-click" system that streamlines the process by which customers place orders.[3]

Patenting an invention is a serious undertaking. To apply for a patent, the inventor must explain how to make and use the invention, and make claims about what it does that makes it a new invention. Drawings of the new invention are also often required. In the United States, this application is reviewed by a patent examiner who may modify the scope of the claims made by the patent. The patent is then published

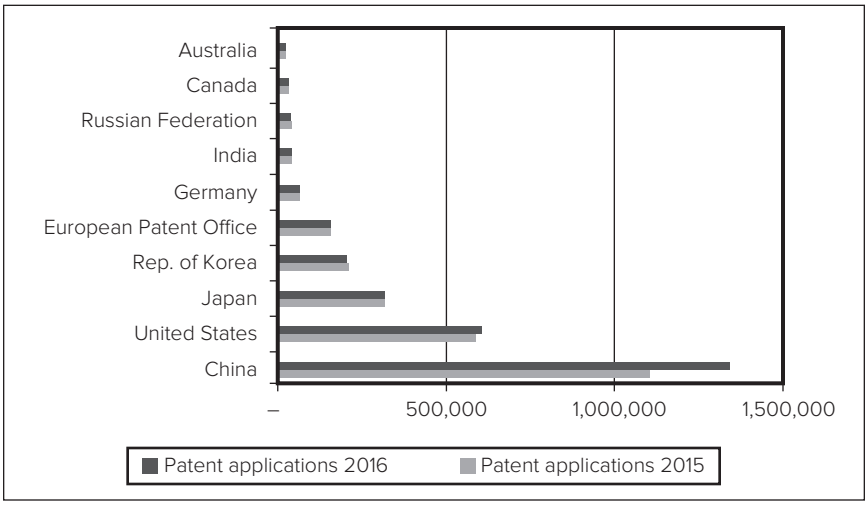

FIGURE 9.1
Patent Applications in 2015 and 2016 in the 10 Largest Patent Offices around the World

Source: WIPO Patent Statistics Database, September 2017.

for a time in which other inventors can challenge the patent grant (if, e.g., they believe that the patent infringes on previously granted patents). If the standards for patentability are met, the patent is then granted. The entire process from application to granting is lengthy. For example, the time from filing to grant is between two and five years in the United States, three and five years in Europe, five and six years in Japan, and five and seven years in India. In industries in which product lifecycles are short, such delays significantly diminish the usefulness of patenting. This has led to a number of proposals for how the patenting system might be reformed to make it more efficient.

The number of patent applications being filed is growing around the world, but nowhere faster than China, which had both the largest number of patent applications in 2015 and 2016, and the largest rate of growth in patent applications (21.5 percent) between 2015 and 2016 (see Figure 9.1).

A number of costs are also involved in filing and maintaining a patent. Fees vary by patenting office. In the United States, the entire patenting process for a "small entity" (e.g., an independent inventor, a small business, or a nonprofit organization) costs around $1500 in filing fees (and roughly double that for large entities), and $5000–$10,000 in attorney fees. In most countries, patent protection lasts for 20 years.

In a major study of historical success rates for U.S. patent applications, Michael Carley, Deepak Hegde, and Alan Marco followed the history of the 2.15 million new patent applications filed at the USPTO after 1996 and found that only 55.8 percent of the applications became granted. Patent applications in the "Drugs and Medical Instruments" sector had the lowest success on average (42.8 percent), and applications in the "Electrical and Electronics" had the highest (66.6 percent). They also found that success was generally lower for small firms and that overall, success rates for all types of applications had gone down over time.[4]

Major International Patent Treaties

There is currently no "world patent," and a patent granted in one country does not automatically provide protection in other countries. In some regions, however, there

are regional patent offices (such as the European Patent Office and the Africa Regional Intellectual Property Organization) that grant patents valid in all the member nations of that program.

Significant differences exist in national patent laws. For example, in most countries, publication of information about the invention before applying for a patent will bar the right to a patent, but the United States allows a one-year grace period (i.e., an inventor can publish an invention up to a year before applying for the patent). Thus, if international patent protection will eventually be sought, inventors must uphold the stricter standard of applying for patent before publishing information about the patent, even if they plan to first patent the invention in the United States. Many countries also require that the invention be manufactured in the country in which a patent was granted within a certain time frame (often three years) from the time the patent is granted. This is called the "working requirement," and it effectively prevents inventors from patenting inventions in countries in which they have no intention of setting up production.

Many inventors wish to patent their inventions in many countries simultaneously. To make that easier, several international treaties have been negotiated between countries that seek to harmonize the patent laws around the world. Two of the most significant are the Paris Convention for the Protection of Industrial Property and the Patent Cooperation Treaty.

The *Paris Convention for the Protection of Industrial Property* (also known as the Paris Convention Priority) is an international intellectual property treaty adhered to by 177 countries as of March 2018. Under the Paris Convention, a citizen of any member country may patent an invention in any of the member countries and enjoy the same benefits of patent protection as if the inventor were a citizen of those countries. That is, the Paris Convention eliminates (for its member countries) any differential patent rights afforded to citizens of the country versus foreign nationals. Furthermore, the treaty also provides the right of "priority" for patents and trademarks. Once an inventor has applied for patent protection in one of the member countries, the inventor may (within a certain time period) apply for protection in all the other member countries. The time period is 12 months for utility patents and six months for design patents and trademarks. Most important, the applications to these later countries will be treated as if they were made on the same date as the first application. This enables the inventor to establish priority over any other patents applied for in those countries after the inventor made the first application. For example, if an inventor applied for a utility patent for an invention in Madagascar in January 2003, and another inventor applied for a patent for a very similar invention in France in June 2003, the Madagascar inventor could have applied for patent protection in France in December 2003 and claim priority over the French invention. The French inventor would have to prove that his or her invention was substantively different from the Madagascar invention, or the French inventor's patent would be denied.

As mentioned previously, in many countries, public disclosure of an invention makes it impossible to subsequently patent that invention. However, with the priority rights established under the Paris Convention, an inventor who patents an invention in one of the member countries can then publicly disclose information about that invention without losing the right to patent the invention in the other countries—each patent

application will be treated as if it were applied for at the same time as the first application, and thus as if it were applied for before public disclosure. Without this treaty, it would be nearly impossible for an inventor to patent an invention first in the United States and then in other countries because U.S. patent applications are made available to the public.

Another very significant international patent treaty is the *Patent Cooperation Treaty*, or PCT. This treaty facilitates the application for a patent in multiple countries. An inventor can apply for a patent to a single PCT governmental receiving office, and that application reserves the inventor's right to file for patent protection in 152 countries for up to two-and-half years. Once the inventor has filed the application, a PCT governmental searching office will perform the patent search for the application (this search verifies that the invention is not already subject to a prior claim). Once the search is completed, the inventor can choose to enter Chapter II of the process wherein the PCT governmental office assesses the patentability of the invention subject to the standards of the Patent Cooperation Treaty. Eventually, the inventor must have the PCT application filed in each of the national patent offices in which the inventor is seeking protection.

Filing a single PCT application offers numerous advantages. First, applying for the PCT patent buys the inventor the option to apply to multiple nations later without committing the inventor to the expense of those multiple applications. With a PCT application, the inventor can establish a date of application in multiple countries (protecting the inventor's priority over later claims), while paying only the single PCT application fee rather than the numerous national application fees. Though the inventor will eventually have to pay for national applications in the countries in which protection is sought, the inventor can delay those costs. Thus, the inventor has time to assess the likelihood of the patent being granted and the potential profitability of the invention. If the PCT process suggests that the patent will not be granted or if it appears the invention has limited potential for earning returns, the inventor can forgo the expense of applying to the national offices.

Another advantage of the PCT process is that it helps make the results of patent applications more uniform. Though individual countries are not required to grant a patent to those inventions that are granted a patent by the PCT governing office, the granting of the patent by the PCT provides persuasive evidence in favor of granting the patent in the individual national offices. As of August 2015, there were 148 member states of the Patent Cooperation Treaty.

Patent Strategies

It is typical to assume that an inventor seeks a patent because they desire to make and sell the invention themselves. However, inventors and firms may monetize patents in a range of different ways, including licensing the technology to others or selling the patent rights to another firm that can better utilize the technology.[5] Furthermore, whereas the conventional wisdom is that most inventors prefer to keep the details of their invention secret before the patent is granted (to prevent rivals from having access to their proprietary knowledge), this turns out not to be the case. A study by Stuart Graham and Deepak Hegde found that the vast majority of patentees prefer to disclose their patent applications *before* they are granted. Both large and small inventors, across

all major technology fields exhibited this preference for early disclosure, presumably because it allows them to publicize their invention's quality and scope to competitors, external investors, and potential licensees. Disclosure via patent application also establishes the date from which patentees can enjoy provisional patent rights.[6]

patent trolling
A pejorative term for when an individual or firm misuses patents against other individuals or firms in attempt to extract money from them.

Firms may also seek patents just to limit the options of competitors or to earn revenues through aggressive patent lawsuits. These actions are sometimes referred to as "**patent trolling**." A patent troll's primary purpose in owning patents is to extort money from other firms. For example, a patent troll might buy a patent from a bankrupt firm to sue another company that it claims is infringing on the purchased patent. Apple claims to be the number one target for patent trolls, having faced nearly 100 lawsuits between 2011 and 2014.[7] According to RPX Corporation, a firm that helps companies resolve patent lawsuits through licensing, patent trolls filed more than 2900 infringement suits in the United States in 2012.[8] This type of predatory patenting has sparked an effort by the U.S. Federal Government to make patent granting stricter and to impose penalties against spurious patent lawsuits.[9]

patent thickets
A dense web of overlapping patents that can make it difficult for firms to compete or innovate.

In industries with complex technologies such as computers, software, and telecommunications, a dense web of overlapping patents known as "**patent thickets**" can make it very difficult for firms to compete without falling prey to patent suits by other firms in that technology domain. This can seriously stifle innovation and has resulted in the rather peculiar strategy of firms buying bundles of patents to create war chests that they hope will deter the patent attacks of others. For example, in 2011, the bankrupt Nortel auctioned off its massive patent portfolio. The auction was won by a consortium called Rockstar Bidco that included Microsoft, Apple, RIM, Sony, and Ericsson, who paid $4.5 billion for the war chest, beating out Google which bid $4.4 billion. Google subsequently bought 1030 IBM patents that covered a range of technologies, from the fabrication of microprocessing chips, object-oriented programming, and other business processes. These patents were not necessary for Google's business directly; rather they provided a retaliation threat to others that might attack them through patent suits.[10] Google also bought Motorola Mobility for $12.5 billion the same year, and it was widely believed that the purchase was almost solely for Motorola's patents, which would bolster Google's position in the lawsuit they expected would arise from the Nortel patents.[11] In October of 2013, confirming Google's fears, Rockstar Bidco filed suit against Google and seven companies that make phones for Google's Android operating system.[12] Google countersued based on its own patents, and in November 2014, it was reported that Google and Rockstar had reached a settlement.[13]

Trademarks and Service Marks

A trademark is a word, phrase, symbol, design, or other indicator that is used to distinguish the source of goods from one party from the goods of others. The "Intel Inside" logo on many computers is one example of a trademark, as is the familiar Nike "swoosh" symbol. A service mark is basically the same as a trademark, but distinguishes the provider of a service rather than a product. Often the term *trademark* is used to refer to both trademarks and service marks.

Trademarks and service marks can be embodied in any indicator that can be perceived through one of the five senses. Most marks are embodied in visual indicators,

such as words, pictures, and slogans. However, marks are also registered that use other senses such as sound (e.g., tones that are associated with a particular company or brand) or smells (as in fragrance). Trademark rights may be used to prevent others from using a mark that is similar enough to be confusing, but they may not be used to prevent others from producing or selling the same goods or services under a clearly different mark.

In most countries, the rights to a trademark or service mark are established in the legitimate use of the mark and do not require registration; however, registration provides several advantages. First, registering the mark provides public notice of the registrant's claim of ownership over the mark. Second, marks must be registered before a suit can be brought in federal court against an infringement of the mark. Third, registration can be used to establish international rights over the trademark, as when the U.S. registration is used to establish registration in other countries, and to protect the mark against infringement from imported products. As of April 2018, the U.S. Patent and Trademark Office charged between $275 and $375 application fee to register a trademark. It normally took 10 to 16 months to receive certification from the U.S. Patent and Trademark Office, but the protection offered by the registration of the trademark begins from the date of filing. Unlike patents and copyrights, trademark protection can last as long as the trademark is in use, but the registration requires periodic renewal.

Major International Trademark Treaties

Nearly all countries offer some form of trademark registration and protection. National or regional offices maintain a Register of Trademarks that contains information on all trademark registrations and renewals. To eliminate the need to register separately in each country (or region), the World Intellectual Property Organization administers a System of International Registration of Marks governed by two treaties: the Madrid Agreement Concerning the International Registration of Marks and the Madrid Protocol. Countries that adhere to either (or both) the Madrid Agreement or Madrid Protocol are part of the Madrid Union. Any individual that lives in, is a citizen of, or maintains an establishment in a Madrid Union country can register with the trademark office of that country and obtain an international registration that provides protection in as many other Madrid Union countries as the applicant chooses. As of April 2014, there were 91 member countries of the Madrid Union.

Copyright

Copyright is a form of protection granted to works of authorship. In the United States, the authors of original literary, dramatic, musical, artistic, and certain other intellectual works can obtain copyright protection.[14] Like trademarks, the rights of copyright protection are established by legitimate use of the work. This protection is available whether or not the work is published and prevents others from producing or distributing that work. Under section 106 of the 1976 Copyright Act, the owner of the copyright has the exclusive right to do (or authorize others to do) the following:

- Reproduce the work in copies or phonorecords.
- Prepare derivative works based upon the work.

- Distribute copies or phonorecords of the work to the public by sale or other transfer of ownership, or by rental, lease, or lending.
- Perform the work publicly, in the case of literary, musical, dramatic, and choreographic works, pantomimes, and motion pictures and other audiovisual works.
- Display the copyrighted work publicly, in the case of literary, musical, dramatic, and choreographic works, pantomimes, and pictorial, graphic, or sculptural works, including the individual images of a motion picture or other audiovisual work.
- Perform the work publicly by means of a digital audio transmission (in the case of sound recordings).

There are, however, limitations to these rights. In particular, in the United States, the doctrine of fair use stipulates that in most circumstances it is not a violation of copyright for others to use copyrighted material for purposes such as criticism, comment, news reporting, teaching, scholarship, or research. Furthermore, some types of work cannot be protected by copyright. For example, work that has not been fixed in a tangible form of expression (e.g., a choreographed dance or improvisational speech that was not notated or recorded) is not eligible for copyright protection. Titles, names, short phrases, slogans, familiar symbols, and lists of ingredients also cannot be copyrighted.

Unlike patent protection, copyright protection is secured automatically when an eligible work is created and fixed in a copy or phonorecord for the first time. No publication or registration with the Copyright Office is necessary to establish this copyright, though registering the copyright is advantageous in that it establishes a public record of the copyright claim and is required before filing an infringement suit in court. As of April 2018, basic online registration of copyright with the U.S. Copyright Office costs $35, and it took about 3 to 10 months to receive a certificate of registration.

Before 1978, copyright protection lasted only 28 years from the time it was secured (though during the last year the author could opt to renew the protection for an additional term). Revisions to U.S. copyright law, however, give copyright protection to works created after 1978 that lasts for the author's life plus an additional 70 years.

Copyright Protection around the World

As with patents and trademarks, no international copyright law automatically protects an author's work throughout the world. Copyright protection varies from country to country. However, most countries do offer copyright protection to both domestic and foreign works, and there are international copyright treaties for simplifying the process of securing such protection. One of the most significant is the Berne Union for the Protection of Literary and Artistic Property (known as the Berne Convention). The Berne Convention specifies a minimum level of copyright protection for all member countries, and it requires member countries to offer the same protection to both its own citizens and foreign nationals. Other treaties include the Universal Copyright Convention (UCC); the Rome Convention for the Protection of Performers, Producers of Phonograms and Broadcasting Organizations; the Brussels Convention Relating to the Distribution of Program-Carrying Signals Transmitted by Satellite; and the World Intellectual Property Organization Copyright Treaty.

TRADE SECRETS

trade secret Information that belongs to a business that is held private.

Rather than disclose detailed information about a proprietary product or process in exchange for the grant of a patent, inventors or firms often will choose to protect their intellectual property by holding it as a **trade secret**. A trade secret is information that belongs to a business that is generally unknown to others. Trade secrets need not meet many of the stringent requirements of patent law, enabling a broader class of assets and activities to be protectable. For example, while the formula for a beverage is not patentable, it can be considered a trade secret. Trade secret law traces its history back to Roman law punishing individuals who induced someone to reveal the details of their employer's commercial affairs.[15]

Information is typically considered to be a trade secret only if it (*a*) offers a distinctive advantage to the company in the form of economic rents, and (*b*) remains valuable only as long as the information remains private. Examples of trade secrets might include information about a firm's customers, its marketing strategies, or its manufacturing processes. Trade secret law protects such information from being wrongfully taken by another party. In the United States, trade secret law is implemented at the state level, but the Uniform Trade Secret Act attempts to make these laws consistent from state to state.

For information to qualify as a trade secret under the Uniform Trade Secret Act, the information must meet the following three criteria:

- The information must not be generally known or readily ascertainable through legitimate means.
- The information must have economic importance that is contingent upon its secrecy.
- The trade secret holder must exercise reasonable measures to protect the secrecy of the information.

If information meets these criteria, the Uniform Trade Secret Act stipulates that its owner can prevent others from benefiting from this information without the owner's permission. In particular, the act states that no individual or group can copy, use, or otherwise benefit from a trade secret without the owner's authorization if they meet *any* of the following conditions:

1. They are bound by a duty of confidentiality (e.g., employees, lawyers).
2. They have signed a nondisclosure agreement.
3. They acquire the secret through improper means such as theft or bribery.
4. They acquire the information from someone who did not have the right to disclose it.
5. They learn about the secret by mistake but have reason to know that the information was a protected trade secret.

In most regions, if owners of a trade secret believe that another party has stolen or improperly disclosed their trade secret, they can ask a court to issue an injunction against further use of the secrets, and they may also be able to collect damages for any economic harm suffered by the improper use of the trade secret. For example, in November 2002, Procter & Gamble sued Potlatch Corporation, claiming that Potlatch had stolen trade secret methods used to produce Bounty paper towels and Charmin

bath tissue by hiring away two of Procter & Gamble's paper manufacturing experts. Potlatch is a large, private-label tissue manufacturer that produces toilet paper, facial tissues, napkins, and paper towels for grocery store chains such as Albertsons and Safeway. By March 2003, the two companies had reached an agreement to settle out of court, keeping the terms of the settlement confidential.[16]

THE EFFECTIVENESS AND USE OF PROTECTION MECHANISMS

The methods used to protect innovation—and their effectiveness—vary significantly both within and across industries.[17] In some industries, such as pharmaceuticals, legal protection mechanisms such as patents are very effective. In other industries, such as electronics, patents and copyright provide relatively little protection because other firms can often invent around the patent without infringing on it (as IBM discovered when Compaq was able to produce a computer nearly identical to its personal computer design). It is also notoriously difficult to enforce patents protecting industrial processes such as manufacturing techniques. If patents provide little protection, the firm may rely more heavily on trade secrets; however, the ability to protect trade secrets also varies with the nature of the technology and the industry context. To protect a trade secret, a firm must be able to expose its product to the public without revealing the underlying technology, but in many cases, revealing the product reveals all.

For some competitive situations, protecting a technology may not be as desirable as liberally diffusing it. In industries characterized by increasing returns, firms sometimes choose to liberally diffuse their technologies to increase their likelihood of rising to the position of dominant design. As discussed in Chapter Four, learning-curve effects and network externalities can cause some industries to demonstrate increasing returns to adoption: The more a technology is adopted, the more valuable it becomes.[18] This dynamic can lead to winner-take-all markets that create natural monopolies. A firm that controls the standard can reap monopoly rents and can exert significant architectural control over both its own industry and related industries.[19]

This enviable position can be so lucrative that firms may be willing to lose money in the short term to improve their technology's chance of rising to the position of dominant design. Thus, firms may liberally diffuse their technologies (through, e.g., **open source software** or liberal licensing arrangements) to accelerate the technology's proliferation and thereby jump-start the self-reinforcing feedback effect that can lead to the technology's dominance. However, the firm often faces a dilemma: If it liberally diffuses the technology to would-be competitors, it relinquishes the opportunity to capture monopoly rents when and if the technology emerges as a dominant design. Furthermore, once control of a technology is relinquished, it can be very hard to regain; thus, such diffusion may result in the firm losing all hope of controlling the technology. Finally, liberal diffusion of the technology can result in the fragmentation of the technology platform: As different producers add improvements to the technology that make it better fit their needs, the "standard" may be split into many nonstandardized versions (as with UNIX, as described in more detail later in the chapter). To resolve these trade-offs, firms often adopt a strategy of partial protection for their innovations, falling somewhere on the continuum between wholly proprietary systems and wholly open systems.

open source software
Software whose code is made freely available to others for use, augmentation, and resale.

Wholly Proprietary Systems versus Wholly Open Systems

wholly proprietary systems Goods based on technology that is owned and vigorously protected through patents, copyrights, secrecy, or other mechanisms. Wholly proprietary technologies may be legally produced and augmented only by their developers.

Wholly proprietary systems are those based on technology that is company-owned and protected through patents, copyrights, secrecy, or other mechanisms. Such technologies may be legally produced or augmented only by their developers. Wholly proprietary systems are often not compatible with the products offered by other manufacturers. Because their operation is based on protected technology, other manufacturers are often unable to develop components that may interact with the proprietary system. Proprietary systems typically provide their developers with the opportunity to appropriate rents from the technology. However, they might also be less likely to be adopted readily by customers as a result of their higher costs and the inability to mix and match components.

wholly open systems Goods based on technology that is not protected and that is freely available for production or augmentation by other producers.

In **wholly open systems**, the technology used in a product or process is not protected by secrecy or patents; it may be based on available standards or it may be new technology that is openly diffused to other producers. Wholly open technologies may be freely accessed, augmented, and distributed by anyone. Such technologies are usually quickly commoditized and provide little appropriability of rents to their developers.

Many technologies are neither wholly proprietary nor wholly open—they are partially open, utilizing varying degrees of control mechanisms to protect their technologies. It is useful to think of a control continuum that stretches from wholly proprietary to wholly open (see Figure 9.2). For instance, most of the major video game console producers (Nintendo, Sony, and Microsoft) utilize a wholly proprietary strategy for their consoles, but a limited licensing policy for their games. The licensing policies are designed to encourage developers to produce games for the systems, while enabling the console producers to retain a great deal of control over the games produced. All games developed for the consoles must be approved by the console producer before they can be made commercially available. For example, in the case of Microsoft, would-be Xbox games developers must first apply to the Xbox Registered Developer

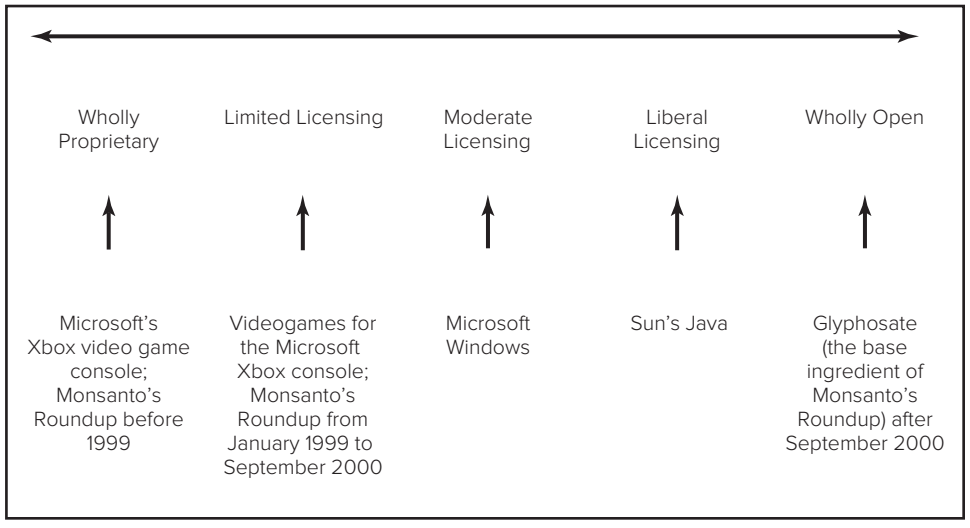

FIGURE 9.2
Examples on the Continuum from Wholly Proprietary to Wholly Open

Program (for established games developers) or the Xbox Incubator Program (for smaller or newer games developers). If accepted into one of these two programs, the developer will receive access to development tools, but this does not guarantee the approval of any resulting game titles. The games are subjected to a separate, rigorous approval process.

By contrast, the licensing policies for Microsoft's Windows are more open. Windows is protected by copyright, and Microsoft defends its exclusive right to augment the software; however, it also permits complementary goods providers to access portions of the source code to facilitate development of complementary goods, licenses the rights to such providers to produce complementary applications, and licenses **original equipment manufacturers (OEMs)** to distribute the software by bundling it with hardware. Those who purchase a license for the software can execute and bundle the software with other goods but may not augment the software. For example, software applications developers may produce and distribute value-added applications for use with Windows as long as those applications do not affect the functionality of the Windows program itself.

original equipment manufacturers (OEMs) Firms that assemble goods using components made by other manufacturers, also called value-added resellers (VARs).

As described in the Theory in Action section later in the chapter, Sun's "community source" (as opposed to "open source") policy for Java is even more open. This policy grants anyone immediate access to the complete source code for Java and allows users to develop commercial applications based on the code, or to augment the code for their own implementations. These developers pay no license fee to Sun. However, any augmentation to the core structure of Java must be approved by the Java Community Process, which is managed by Sun. Sun's "community source" principle is meant to encourage the broader software community to improve Java and develop complementary applications, but it allows Sun to retain some control over the core platform to ensure that the platform does not become fragmented through unmanaged development by the software community.

Many technologies that were once wholly proprietary or partially open become wholly open once their patents or copyrights expire. For instance, Monsanto's highly profitable Roundup herbicide is based on a patented chemical ingredient called glyphosate. This extremely potent herbicide was adopted by farmers in more than 100 countries and accounted for a substantial portion of Monsanto's sales.[20] However, facing impending expiration of its patents, Monsanto began to license the rights to glyphosate production to a few other companies (including Dow Agrosciences, DuPont, and Novartis) in 1999. In September 2000, the U.S. patent on glyphosate expired, and any chemical company was free to produce and sell glyphosate-based herbicides in the United States, making glyphosate a wholly open technology.

Advantages of Protection

Because proprietary systems offer greater rent appropriability, their developers often have more money and incentive to invest in technological development, promotion, and distribution. If a single firm is the primary beneficiary of its technology's success, it has much greater incentive to invest in further developing the technology. The profits from the technology may be directly reinvested in further improvements in the technology. The sponsor of a proprietary technology might also adopt a penetration pricing strategy (i.e., it may offer the technology at a low price or free) to rapidly build

Theory in Action IBM and the Attack of the Clones

In 1980, IBM was in a hurry to introduce a personal computer. When personal computers first began to emerge at the end of the 1970s, most of the major computer manufacturers considered it no more than a peculiar product for a hobbyist market. The idea that individuals would want personal computers on their desks seemed ludicrous. However, as total U.S. personal computer sales reached $1 billion, IBM began to worry that the personal computer market could actually turn out to be a significant computer market in which IBM had no share. To bring a personal computer to market quickly, IBM decided to use many off-the-shelf components from other vendors, including Intel's 8088 microprocessor and Microsoft's software. However, IBM was not worried about imitators because IBM's proprietary basic input/output system (BIOS), the computer code that linked the computer's hardware to its software, was protected by copyright. While other firms could copy the BIOS code, doing so would violate IBM's copyright and incur the legendary wrath of IBM's legal team.

However, getting around IBM's copyright turned out not to be difficult. Copyright protected the written lines of code, but not the functions those codes produced. Compaq was able to reverse-engineer the BIOS in a matter of months without violating IBM's copyright. First, a team of Compaq programmers documented every function the IBM computer would perform in response to a given command, without recording the code that performed the function. This list of functions was then given to another team of "virgin" programmers (programmers who were able to prove that they had never been exposed to IBM's BIOS code).[a] These programmers went through the list of functions and wrote code to create identical functions. The result was a new BIOS that acted just like an IBM BIOS but did not violate its copyright. Compaq sold a record-breaking 47,000 IBM-compatible computers in its first year, and other clones were quick to follow.

[a] R. Cringely, *Accidental Empires* (New York: HarperCollins, 1992).

its installed base, it may spend aggressively on advertising to increase awareness of the technology, and it may even subsidize the production of complementary goods to increase the desirability of its technology to customers. A firm may be willing to lose money in the short term to secure the technology's position as the standard, because once the technology has emerged as a standard, the payoff can be substantial and enduring. By contrast, when multiple firms can produce a technology, losing money on the technology in the short term to promote it as a standard is highly risky because the long-term distribution of the payoffs is uncertain. While the technology's developer may have borne the bulk of the cost in developing the technology, multiple firms may vie for the profits to be made on the technology.

architectural control
The ability of a firm (or group of firms) to determine the structure, operation, compatibility, and development of a technology.

Protecting the technology also gives the developing firm architectural control over the technology. **Architectural control** refers to the firm's ability to determine the structure and operation of the technology, and its compatibility with other goods and services. It also refers to the firm's ability to direct the future development path of the technology. Architectural control can be very valuable, especially for technologies in which compatibility with other goods and services is important. By controlling the technology's architecture, the firm can ensure that the technology is compatible with its own complements, while also restricting its compatibility with the complements produced by others.[21] The firm can also control the rate at which the technology is upgraded or refined, the path it follows in its evolution, and its compatibility with previous generations. If the technology is chosen as a dominant design, the firm

with architectural control over the technology can have great influence over the entire industry. Through selective compatibility, it can influence which other firms do well and which do not, and it can ensure that it has a number of different avenues from which to profit from the platform.

Microsoft's Windows is the quintessential embodiment of this strategy. Because Windows is the dominant operating system in the personal computing market and because it serves as the interface between a computer's hardware and software, Microsoft has considerable market power and architectural control over the evolution of the personal computer system. Among other things, Microsoft has been able to incorporate ever more utility programs into the core program, thereby expanding and taking over the roles of many other software components. Once a user purchased an operating system, uninstaller programs, disk-compression programs, and memory management programs separately, but Windows 95 and 98 integrated all these products and more into the operating system. This "feature creep" had a major impact on competition in the industry; many utility producers such as Qualitas, Stac Electronics, Microhelp, Quarterdeck, and others were forced to abandon their once-profitable products.

Advantages of Diffusion

The primary argument for diffusing a technology instead of protecting it is that open technologies may accrue more rapid adoptions. If multiple firms are producing, distributing, and promoting the technology, the technology's installed base may accumulate much more rapidly than if one firm alone is responsible for such activities. Competition among producers may drive the price of the technology down, making it more attractive to customers. Both customers and complementary goods providers may also perceive the technology as better (or its future more certain) if there are multiple companies backing the technology. This perception can lead to much more rapid adoption of the technology by customers and complementary goods providers, which further stimulates more companies to back the technology. Thus, a liberal diffusion strategy can stimulate the growth of the installed base and availability of complementary goods.[22]

Google used a liberal diffusion strategy to help its Android operating system for smartphones become widely adopted. Google's liberal licensing policy for Android attracted many handset manufacturers and applications developers to the system, enabling its ecosystem to grow rapidly. A larger ecosystem with more phone models, price points, and applications, in turn, attracted a wider range of customers.

Open technologies can also benefit from the collective development efforts of parties external to the sponsoring firm. For instance, Netscape Navigator, UNIX, and Linux are all technologies that have benefited significantly from external development. By making the source code freely available to the vast world of developers who could benefit from the technology, the technologies reaped the advantages of having a much larger pool of talent and resources directed at improving the technologies than could have been rallied by the original developers.

External development, however, poses some costs and risks. First, external development efforts typically lack the coordination of internal development. External developers may have very diverse objectives for the technology; rather than work together toward some unified vision of what the technology could achieve in the future, they

might work in different, possibly even conflicting, directions.[23] Much of their effort may be redundant, as different external developers work on solving the same problems without communicating with each other. Finally, whether and how these improvements get incorporated into the technology and disseminated to other users of the technology can prove very problematic. UNIX provides a stark example of this.

UNIX was an operating system first developed by AT&T's Bell Laboratories in 1969. Though a Department of Justice injunction forbade AT&T from selling software commercially, it made the source code for the product available through licensing arrangements. Early licensees (notably, University of California—Berkeley) began using and adapting the software for their purposes, causing many incompatible versions of the software to emerge. Though the software community made several attempts to standardize the UNIX operating language, their efforts failed. AT&T also challenged the commercialization of several UNIX variants, but to no avail. Ultimately, AT&T sold the division responsible for UNIX to Novell, and Novell handed over the rights to the UNIX trademark to the X/Open standards-setting body.[24]

Given the range of advantages (and risks) of protecting versus diffusing a technology, a firm must carefully consider the following factors in deciding whether, and to what degree, it should protect its innovation.

Production Capabilities, Marketing Capabilities, and Capital

If the firm is unable to produce the technology at sufficient volume or quality levels (or market the technology with sufficient intensity), then protecting the technology so that the firm is its sole provider may significantly hinder its adoption. For example, when JVC was promoting its VHS standard for video recorders, its management knew JVC was at a disadvantage in both manufacturing and marketing capabilities compared to Sony (which was promoting the Beta technology). JVC chose to vigorously pursue both licensing and OEM agreements, lining up Hitachi, Matsushita, Mitsubishi, and Sharp to boost the technology's production rate.

Similarly, if complementary goods influence the value of the technology to users, then the firm must (*a*) be able to produce the complements in sufficient range and quantity, (*b*) sponsor their production by other firms, or (*c*) encourage collective production of the complements through a more open technology strategy. The only firms that have been successful in the U.S. video game industry were those that were able to produce games in-house (ensuring that a wide range of games would be available at the console's launch) and that encouraged third-party development of games (to ensure that the number of game titles grew quickly). Both Nintendo and Sega had previous arcade experience, and thus possessed considerable game development expertise. Microsoft had long been a producer of PC-based video games, so it had some game developing experience, and it also acquired a few small game developers (e.g., Bungie) to expand its expertise in developing console-type games.[25] Sony had no prior game experience, but aggressively acquired in-house developers, licensed external developers, and set up a program with Metrowerks to provide developer tools that would make it easier for external developers to produce PlayStation games. If a firm lacks the production capability or expertise to produce a sufficient range of complementary goods, or the capital to acquire such capabilities quickly, it should encourage collective production of complements through a more open technology strategy and utilize forms of sponsorship.

Industry Opposition against Sole-Source Technology

Sometimes other industry members are able to exert strong pressure against the adoption of a technology that would give one (or a few) producer(s) undue control and power, causing a technology that is restricted to such production to be rejected or more hotly contested than a more open technology. This was the case with Sony and Philips' Super Audio CD (SACD) audio format. Sony and Philips had jointly created the original compact disc (CD) format and split the royalties on every CD player sold, totaling hundreds of millions of dollars. The rest of the world's leading consumer electronics producers (including Hitachi, JVC, Matsushita, Mitsubishi, and Toshiba) and record producers (including Time Warner and Seagram's Universal Music group) banded together to form the Digital Video Disk (DVD) Audio consortium. This consortium's purpose is to promote the DVD Audio standard that is intended to displace the CD and enable royalties to be split among the 10 companies that control the patents.[26] Industry observers note that a driving force underlying the formation of the consortium was to prevent Sony and Philips from controlling yet another generation of audio formats. The degree of industry opposition to a sole-source technology needs to be considered when the firm formulates its technology strategy. If the industry is able to pose significant opposition, the firm may need to consider a more open technology strategy to improve the technology's likelihood of being chosen as a dominant design.

Resources for Internal Development

If a firm does not have significant resources (capital, technological expertise) to invest in the technology's functionality, it may have difficulty producing a technology that has an initial performance level, and rate of improvement, that the market finds attractive. In such instances, it can be valuable to tap the external development efforts of other firms (or individuals) through utilizing a more open technology strategy. For example, when Netscape found itself in a race to match browser capabilities with Microsoft, it was at a tremendous disadvantage in both human resources and capital. Microsoft had legions of internal developers and a lot of money to invest in Explorer; there was no way that Netscape could match those resources internally. Instead, Netscape tapped the external development community by giving them access to its source code and incorporating their improvements into the Navigator product.

Control over Fragmentation

For technologies in which standardization and compatibility are important, maintaining the integrity of the core product is absolutely essential, and external development can put it at risk. As the UNIX example illustrates, if the developing firm relinquishes all control over the development of the technology, the technology will have no shepherd with the ability and authority to direct its trajectory and ensure that a single standard remains intact. This suggests that the developer of any technology that requires standardization and compatibility should retain some degree of control over the technology, or find/establish another governing body with the authority to do so.

Incentives for Architectural Control

Architectural control over the evolution of a technology is always valuable; however, it becomes particularly valuable if a firm is a significant producer of complements to

the technology in question. A firm with architectural control can typically design the technology to be compatible with its own complements and incompatible with those of competitors. If the technology is chosen as the dominant design, this architectural control allows the firm to ensure that it reaps the lion's share of the rewards in complements production. Furthermore, by making the technology selectively compatible with some competitors and not others, the firm can exert great influence over the competitive field.

Architectural control can also enable the firm to direct the development efforts put into the technology so that it exploits the firm's core competencies. Technology trajectories are path dependent; minor events in their evolution can set them careening off into unexpected directions. A firm that has a significant stake in a particular evolution path (because, e.g., it has technological competencies that are much more amenable to one path of evolution than other potential paths) may place a high value on architectural control, which can enable it to co-opt or destroy less favorable development paths by denying their progenitors access to the market.

Summary of Chapter

1. The degree to which a firm can capture the rents from its innovation efforts is largely determined by the degree to which competitors can quickly and easily imitate the innovation. Some innovations are inherently difficult to copy; others are difficult to copy because of the mechanisms the firm uses to protect its innovation.
2. The three primary legal mechanisms used to protect innovation in most countries are patents, trademarks, and copyrights. Each mechanism is designed to protect a different type of work or good.
3. International treaties have helped to harmonize patent, trademark, and copyright laws around the world. Most countries now have patent, trademark, and copyright laws of some form, and in some instances protection can be applied for in multiple countries simultaneously.
4. Trade secrets provide another mechanism of protecting innovation. Firms that protect their intellectual property as a trade secret often have legal recourse if another party wrongfully takes and uses such property.
5. Legal mechanisms for protecting innovation are more effective in some industries than others; in some industries, inventing around a patent or copyright is relatively easy. Similarly, in some industries, it is nearly impossible to protect an innovation by using trade secrets because commercializing the innovation reveals its underlying technologies.
6. Sometimes the choice between protecting versus diffusing a technology is not obvious. Both strategies offer potential advantages. Many firms use neither a wholly open nor a wholly proprietary strategy, but rather a partially open strategy.
7. Protecting an innovation helps ensure that the firm earns the lion's share of the returns from the innovation. These returns can then be reinvested in further developing the technology, promoting the technology, and producing complementary goods.
8. Protecting an innovation also preserves the firm's architectural control, enabling it to direct the technology's development, determine its compatibility with other

goods, and prevent multiple incompatible versions of the technology from being produced by other firms.

9. Diffusing a technological innovation can encourage multiple firms to produce, distribute, and promote the technology, possibly accelerating its development and diffusion. Diffusion can be particularly useful in industries that accrue increasing returns to adoption. It is also useful when the firm has inadequate resources to be the sole developer, producer, distributor, and marketer of a good.

Discussion Questions

1. What are the differences between patents, copyrights, and trademarks?
2. What factors should a firm considering marketing its innovation in multiple countries use in formulating its protection strategy?
3. When are trade secrets more useful than patents, copyrights, or trademarks?
4. Identify a situation in which none of the legal protection mechanisms discussed (patents, copyrights, trademarks, trade secrets) will prove useful.
5. Describe a technological innovation not discussed in the chapter, and identify where you think it lies on the control continuum between wholly proprietary and wholly open.
6. What factors do you believe influenced the choice of protection strategy used for the innovation identified above? Do you think the strategy was a good choice?

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