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For modern technologies, access to intellectual property rights (IPR) is complex because it is fragmented among many owners. The required licensing agreements invoke considerable transaction costs and royalty stacking. Often, it is in the interest of the technology sponsor to ease access to the required IPR. Patent pools have proven useful to achieve this goal. This article examines the experiences with three generations of patent pools in the optical disc industry. Technology platforms are becoming increasingly complex, which leads to a fragmentation of IPR among many pools and causes new issues. A novel “pool-of-pools” can address these.

(Keywords: Patents, Intellectual Property, Licensing, Standardization, Technological Innovation, New Product Management, Disruptive Technology)

The development of consumer electronics, telecommunications, computers, and related high-tech industries is defined by a myriad of technologies. Increasingly, these technologies involve numerous blocking patents owned by multiple patent owners. A recent example is the competition between three prominent smartphone operating systems: iOS, Android, and Windows Mobile. The companies that developed these operating systems use patents to make the other platforms more expensive and spread uncertainty among app developers. When a technological field develops through the contributions of many entities, negotiating the number of requisite patent licenses may become inefficient and too costly for users. To solve this issue, which is inevitable for any area where many parties invest in research and development, companies increasingly employ a patent pool licensing model. A patent pool aggregates intellectual property rights (IPR) for the purpose of joint licensing. It is an innovative business model to enhance technology adoption and IPR monetization by facilitating the interaction of multiple licensors with many licensees. This article analyzes the conditions for successful patent pools by examining three generations of patent pools in the optical disc industry. We observe that patent pools are becoming more and more sophisticated. The current state of the art is
the novel “pool-of-pools.” We present a generic framework to guide strategy and innovation managers in establishing and managing a patent pool through the four phases of its lifecycle.

Using Patent Pools to Facilitate Market Adoption and Appropriate IPR

Companies have been pooling patents since the mid-1900s. However, due to antitrust scrutiny, the concept was nearly abandoned until in 1995 the U.S. Department of Justice (DoJ) issued new intellectual property guidelines that recognized the precompetitive aspects of patent pools. These guidelines triggered the creation of “modern” patent pools in a wide variety of industries (shown in Figure 1), many of them emerging out of co-created technologies such as compatibility standards and platform technologies. A compatibility standard is the technical specification of an interface between interacting components. Examples include MPEG-2 digital video compression, Bluetooth wireless personal area networking, and RFID non-intrusive identification. Platform technologies are products or services that act as a foundation upon which an array of complementary products (e.g., software, movies, or music) can be offered. A well-known example is the DVD platform and the movies available on DVD discs. Technology platforms can incorporate multiple compatibility standards; the movies on DVD discs are compressed using MPEG-2 for the images and Dolby Digital

FIGURE 1. Number of Patent Pools Established Since 1995

* This figure provides a non-exhaustive overview of which the data were derived from multiple sources, e.g., David Serafino, “Survey of Patent Pools Demonstrates Variety of Purposes and Management Structures,” KEI Research Note, June 2007; websites from various license administrators such as MPEG LA, SISVEL, Via Licensing, and SIPRO LAB.
for audio. In the last decade, patent pools have expanded to new areas, unrelated to compatibility standards. Some examples include agricultural technologies such as the “Golden Rice pool,” pharmaceuticals such as the Medicines Patent Pool that aims to facilitate the development of better-adapted HIV medicines (e.g., special formulations for children), and Librassay which provides a one-stop license for diagnostics and tools in support of personalized medicine and healthcare.

Modern patent pools have the following characteristics:

• all pooled patents are available to licensors participating in the pool, as well as to external licensees;
• licensees are offered standard licensing terms, usually a simple, coherent menu of “patent packages” with prices and other terms;
• licensing fees are allocated to each member according to a pre-set formula or procedure;
• an independent party is involved to evaluate the essentiality of patents before they are included in the pool;
• membership for licensors is voluntary, and most allow additional patent owners to join after formation of the pool; and
• they include various adjustment mechanisms for adding new patents and recalibrating royalty shares.

Modern patent pools often bundle patents for a specific compatibility standard, because antitrust authorities require such pools to include complementary patents only, and patents that are essential for implementing a standard are by definition complementary. Pooling patents for technologies that directly compete is regarded as anticompetitive. In 2002, there was an initiative to establish a “3G platform pool” to pool patents into packages constituting five competing compatibility standards for 3G mobile telecommunications. Under pressure of the competition authorities, the proposal had to be changed to ensure that each standard would have its own pool, with independent decision and price setting structures. Only for one of these standards was a pool actually formed.

Why Firms Engage in Patent Pools

Managers in strategy and innovation are increasingly challenged to move beyond conventional thinking and need to compete on the basis of technology platforms. Competitions between technology platforms are subject to network externalities: the technology with the largest number of users attracts providers of complementary products, which, in turn, increases the technology’s utility to a customer. These self-reinforcing feedback loops result in a virtuous cycle that often “tips” a competition in favor of the technology that has the leading user base or the complementary products that offer most utility. These “winner-take-all” markets demonstrate different competitive dynamics than markets in which competitors coexist relatively peacefully. A company does not need to have the best technology to achieve a dominant market share. Companies need to encourage innovation around their platforms at the broad industry level (i.e., create an
ecosystem of businesses that support the platform) because the value of their platforms depends on the availability and innovativeness of complementary products and services.

In order to jump start the self-reinforcing feedback loop and outcompete technological alternatives, companies have started to collaborate in developing the platform’s technology and compete with each other in providing differentiated but compatible versions of the “shared” platform. However, involving multiple parties during technology development allows these to contribute their inventions and related IPR. The result is a “patent thicket”; an overlapping set of patent rights requiring those that seek to commercialize new technology to obtain licenses from multiple patentees. Circumventing the IPR by implementing alternate inventions is typically impractical, as it would preclude the manufacturer from claiming that its products are compliant and thus assuring consumers that they are fully compatible. Patent thickets lead to three problems:

- each individual patent holder may charge a royalty that seems reasonable when viewed in isolation, but together the royalties represent an unreasonable burden;
- even if other firms agree to license their patents at a modest rate, a hold-up problem may result if a single firm sets a high license fee for its technology; and
- the very process of obtaining the required licenses may prove to be time consuming.

The rapid growth in research and development expenditures, number of patents, patent holders, and their diversity is making it increasingly difficult to navigate through these thickets. This affects high-tech industries in general, including agriculture, pharmaceuticals, and personalized healthcare.

With such excessive IPR, co-created technologies are likely to be underused. However, in several cases (e.g., CD, DVD, Blu-ray, and MP3) sponsors of co-created technologies have been effective in establishing an industry ecosystem by using patent pools to simplify the patent thicket. Patent pools create transparency, a level playing field, and facilitate market adoption. For licensees, patent pools function as a one-stop shop to access a technology’s IPR. They offer lower transaction cost and a discounted royalty compared to concluding multiple individual licenses. These lower costs make the technology more attractive and are beneficial for its users. For licensors, patent pools lead to higher profits due to the more effective and efficient licensing and collection of royalties. For example, AT&T has signed up 13 licensees for patents essential for implementing the popular H.264/Advanced Video Coding (AVC) standard. In contrast, the AVC patent pool, in which 29 other companies have united their essential patents, has attracted over 1,100 licensees. Due to the increasing use of IT and telecommunications standards as enabling technologies in larger systems, tomorrow’s market will have to deal with many more diverged buyers, rendering bi-lateral licensing between patent holders increasingly ineffective. Examples include intelligent transport systems, where RFID tags now play a central role, and banking, with mobile payments. This trend will continue into many more areas, such as smart grids, personal health, and the “internet-of-things.”
Difficulties in Implementing Patent Pools

Establishing a patent pool is not easy, and its benefits are rarely realized to the full extent. Lerner and Tirole\(^\text{19}\) identify several factors that restrict the formation of pools:

- **Negotiating Cost**—Forming a pool involves a process with substantial legal expenditures. The benefits of forming a pool have to be compared with the resulting costs.
- **Asymmetric Information**—Asymmetries in information (e.g., regarding the value of individual patents) can cause bargaining breakdown.
- **Self-Imposed Constraints**—Efficient bargaining requires sufficient flexibility to tailor patent pool conditions (e.g., license fee and royalty distribution) to individual needs and bargaining powers. Many pools go for an equal treatment of all members.

In addition, a patent pool can only be successful if it manages to obtain a critical mass of IPR. The more parties involved in the development of a co-created technology, the more IPR is fragmented among many owners. As Figure 2 illustrates, the first generation of a technology platform or compatibility standard is often covered by relatively few patents, but as subsequent generations are developed and experience path dependency,\(^\text{20}\) the number of patents and patent holders rapidly increases.\(^\text{21}\) While a high number of patent owners makes one-stop shopping especially attractive, it is also more difficult to negotiate a patent pool arrangement.

**FIGURE 2.** Indicative Number of Essential Patent Families Associated with Subsequent Technology Generations in Optical Discs, Mobile Telecommunications, and Video Coding
In addition to the increasing number of essential patents per subsequent technology generation, there are two other trends that are enhancing the IPR fragmentation. Firstly, to facilitate customers to switch to a new platform, implementers often need to offer backwards compatibility by incorporating several technology generations into products: a Blu-ray player is expected to play older DVDs, and a 3G smartphone is expected to make calls on older GSM networks. Each of these technology generations comes with its own set of essential IPR and IPR owners. Secondly, there is an increased convergence of functionalities into devices and products. Whereas traditional technologies could often be exploited as a device or service in its own rights, today’s devices often incorporate many different technologies. The evident example is the smartphone that includes a camera, a music player, an internet browser, GPS, and much more. A modern Blu-ray player will often include internet access, streaming video services, and Wi-Fi. As the level of complexity increases, patent pool formation becomes more demanding.

**Patent Pools in the Optical Disc Industry**

To demonstrate how companies can successfully manage their IPR on co-created technologies and deal with the increasing complexity, we describe the evolution of patent pools in the optical disc industry. The success of the first optical disc platform, the Compact Disc (CD), fostered several generations of shared platforms that became the market standard. These generations display different levels of maturity with regard to the number of essential patents, and the number of companies involved. The optical disc is one of the most successful technology platforms of all times. The related patent pools were among the first of the modern patent pools and their success has made them an example for others. Over time, the optical disc platforms also enveloped other areas such as video and computer data storage, thereby entering the domain of other companies with their own IPR interests. Nevertheless, most companies agreed to bring their essential patents into a patent pool. Table 1 shows an overview of three optical disc generations, their patent pools, and the main characteristics of these pools.

**The Compact Disc**

In 1979 Philips and Sony combined their technologies for optical discs in a shared platform, the Compact Disc (CD). Although both were major players in the consumer electronics industry, they realized additional market momentum was required to replace the installed base of the LP and Compact Cassette. Therefore, they decided to license the CD technology. To facilitate platform support and enable other parties to easily manufacture interoperable products, the specifications of the CD discs and players were described in the “Red Book.” After the Red Book was finalized in 1980, other companies could access it to develop prototypes and evaluate the platform.

In order to make it easy for companies to obtain a license, Sony and Philips decided to jointly license their CD patents. Sony appointed Philips to act as the
**TABLE 1.** Overview of Three Optical Disc Generations and Main Characteristics of Their Patent Pools**

<table>
<thead>
<tr>
<th></th>
<th>CD Audio</th>
<th>DVD Video</th>
<th>Blu-ray Video</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year of market introduction</td>
<td>1982</td>
<td>1996</td>
<td>2006</td>
</tr>
<tr>
<td>Billions of discs sold worldwide</td>
<td>100</td>
<td>62</td>
<td>2</td>
</tr>
<tr>
<td>Billions of players sold worldwide</td>
<td>2.8</td>
<td>1.3</td>
<td>0.1</td>
</tr>
<tr>
<td>Patents divided over owners</td>
<td>Philips-Sony joint license</td>
<td>Philips, Sony, Pioneer (3)</td>
<td>Hitachi, Matsushita, Mitsubishi Electric, Time Warner, Toshiba, JVC (6)</td>
</tr>
<tr>
<td>Administrator</td>
<td>Philips</td>
<td>Philips</td>
<td>Toshiba</td>
</tr>
<tr>
<td>Comfort letter</td>
<td>n/a</td>
<td>December 1998</td>
<td>June 1999</td>
</tr>
<tr>
<td>No. of licenses</td>
<td>118 (discs), 51 (players)</td>
<td>551</td>
<td>467</td>
</tr>
<tr>
<td>No. of essential patents</td>
<td>~100</td>
<td>263</td>
<td>608</td>
</tr>
<tr>
<td>Player royalties</td>
<td>2% of net sales price</td>
<td>3.5% of net sales price, minimum of $7.00 (dropped to $5.00 after 2000)</td>
<td>4% of net sales per unit, minimum of $4.00</td>
</tr>
<tr>
<td>Disc royalties</td>
<td>$0.03</td>
<td>$0.075</td>
<td>$0.0725</td>
</tr>
<tr>
<td>Royalty allocation method</td>
<td>Fixed</td>
<td>Each patent weighs equally (per-patent basis)</td>
<td>Limited number of divisionals, differentiation on application and physical format, differentiation on market and manufacturing countries</td>
</tr>
<tr>
<td>Royalty collection</td>
<td>Post-netting principle</td>
<td>Post-netting principle, batch license, customs program</td>
<td>Post-netting principle, batch license, mandatory participation in enforcement action, enforcement fund</td>
</tr>
<tr>
<td>Patent pool administrator</td>
<td>Philips</td>
<td>Philips</td>
<td>Toshiba</td>
</tr>
<tr>
<td>Patent pool administrator comfort letter</td>
<td>n/a</td>
<td>December 1998</td>
<td>June 1999</td>
</tr>
<tr>
<td>Original licensors</td>
<td>Philips, Sony (2)</td>
<td>Philips, Sony, Pioneer (3)</td>
<td>Hitachi, Matsushita, Mitsubishi Electric, Time Warner, Toshiba, JVC (6)</td>
</tr>
<tr>
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</tbody>
</table>

patent pool administrator, responsible for issuing licenses and collecting license fees. This role proved to be an effective solution. Philips had the licensing experience, only two companies were involved, the number of patents was relatively small, and the patent climate in the early 1980s was easy and benign. While, Philips and Sony held most of the patents on CD, there was also a third company, DVA. DVA’s patents were developed for LaserDisc, CD’s failed predecessor that was co-created by Philips and DVA. DVA licensed its patents separately, and was later acquired by Pioneer.

The patent pool consisted of the patents essential for implementing the Red Book, and these were offered as separate “patent packages” for the discs and players. This allowed the hardware manufacturers and record labels to take a license on the package they required. The licenses also included the use of a logo, which showed consumers that the products were interoperable. Licensees could only use the logo after the products were independently certified for adhering to the specifications in the Red Book. Because of this tight link between the logo, Red Book, and patent pool license, it was clear that every product with a logo was subject to license fees.

The approach of the Red Book and the joint licensing program proved to be very successful. Matsushita announced support for the CD format in January 1981, which meant that the three largest consumer electronics manufacturers supported the format. Other manufacturers followed suit and by March 1982 the format was supported by 30 CD player manufacturers. During the development of the CD, two major record labels, CBS/Sony and Philips’s Polygram announced their support for the format. Nevertheless, due to the license fee demanded by Philips and Sony for the discs, the record industry threatened to become organized and offer almost unanimous resistance several months before Philips and Sony’s 1982 product launch. With the prospect of the CD format being rejected by the music industry, Sony decided to drop its royalty claims for the discs, which left Philips as the sole recipient. As a result, any organized effort to resist this technology could face antitrust consequences. The collective action did not occur, and many record companies decided to become licensees of the format instead. By August 1983, the format had 55 licensees: 39 player manufacturers and 16 disc producers who collectively offered 1,000 titles.

With the successful market adoption of the CD, Philips had to take measures to counteract illegal manufacturing. It set up a dedicated team that proactively attended trade shows and approached parties without a license on the patents.

The Digital Versatile Disc

After the success of the CD, the platform was successfully leveraged as CD-ROM (Yellow Book) for the market of computer software distribution and as CD writeable and re-writeable (Orange Book) for the data copying market. The next step was to enter the market for video storage and distribution. Initially, Sony, Philips, Toshiba, and Time Warner explored the possibility to enter this market with a shared platform, but this was unsuccessful and they split up in two camps. Sony and Philips developed the MultiMedia CD. Toshiba and Time Warner, joined by Matsushita, developed the SuperDensity Disc. With a platform competition looming, the computer and movie industry pressured the respective camps to merge
their formats into a single platform. In 1995, agreement on a unified concept, the Digital Versatile Disc (DVD), was announced. With the major consumer electronics companies and some of the major film studios supporting DVD, it quickly became popular and in six years it replaced VHS videotapes as the market standard. However, the uneasy merger of the two platforms was limited to pre-recorded discs. When the companies set out to extend the format to writeable and re-writeable discs, the competition flared up again and the two camps introduced their own formats (DVD+R and DVD-R). Both sides recognized the importance of creating a patent pool for DVD, but their competition led each to establish their own pool. Philips, Sony, and Pioneer established the DVD3C pool, while Toshiba, Time Warner, Matsushita, Hitachi, JVC, and Mitsubishi set up the DVD6C pool.

The patent pools were established in several steps. First, the major patent owners established small groups of companies that were interested to create a pool together. These groups internally discussed the main parameters of their patent pools:

- The companies of the DVD3C patent pool appointed Philips as license administrator, and the companies in the DVD6C pool appointed Toshiba as administrator.
- The license fees were defined as modest royalties. The main business of the patent holders was to market and sell products. Therefore, they were also licensees, and stood to benefit from reasonable fees.
- The pools chose the post-netting principle to calculate royalty payments. This meant that a licensee would make full royalty payments to the patent pool regardless of any licenses that the licensee already had on patents in the pool, for which refunds would have to be arranged outside the pool.
- Allocation of the royalties for DVD6C was based on the number of essential patents, multiplied by the number of countries in which the patents were filed. For DVD3C, there was a fixed allocation based on the number of essential patents and the contribution of the firms to the platform’s development.
- If a non-licensee infringed on the patents in the pool, each individual firm in the pool could choose to make its patents available for an enforcement action.

Following agreement on these parameters, the two groups issued a call for other patent holders to join. The interested patent holders submitted their patents to an independent evaluator (a patent attorney or a law firm specialized in IPR), which determined if they were essential for implementing the platform. The last step was to check compliance with international antitrust regulation. The initiators of the DVD3C and DVD6C patent pools collectively held a large market share in the consumer electronics industry, and their IPR could potentially be used to create entry barriers. To check whether the proposed patent pools were considered pro-competitive, the respective companies requested a comfort letter (also known as Business Review Letter), which is a statement of the DoJ’s intentions not to challenge the pool. There are several must-haves for approval: the patents should be essential for implementing the technology and complement each other, licensors
should be permitted to license their patents outside the pool, and royalty rates must be reasonable and nondiscriminatory. DVD3C was the first to receive notification that the pool would not be challenged, and DVD6C received the same response in the following year. After the respective comfort letters were secured, the license administrators initiated the worldwide licensing effort. It took two years to complete the process of setting up the patent pools.

Once operational, the patent pools were open to new licensors who could add their essential patents to the joint license under the same terms and conditions as other patent holders. Licensees that owned essential patents were obliged to grant a license back to the other patent holders in the pool under similar terms and conditions. The patent pool retained the right to suspend a license when a licensee defaulted on its commitments. Moreover, a patent owner was allowed to remove its patents from license coverage as to a particular licensee if that licensee brought a lawsuit for infringement of a related patent against the licensor.

The license for the DVD format and the essential patents were separated. So in order to manufacture DVD discs or players, a licensee had to obtain the technical specification and a logo license from the DVD Forum (a legal entity in which the DVD platform sponsors collaborated to promote the market adoption of the platform). Subsequently, they had to deal with two separate patent pools for DVD products, a number of individual DVD patent holders, various CD patent pools (not only on CD audio, but also on CD-ROM and CD-recordable) and additional CD licenses from individual companies. This fragmentation resulted in royalty stacking and increased transaction costs for both licensors and licensees. Due to the large number of licensors, the playing field became more antagonistic. Each pool and individual company adopted its own strategy for enforcement. A trend developed in which some companies signed a license agreement, but deliberately failed to pay royalty fees. A licensee that does not pay royalties (or only a small portion) has a competitive advantage over licensees that do. While it is relatively easy to act against a non-licensee that infringes patents, legal action to force a licensee that is unwilling to pay is difficult and can take years. To tackle this problem for the DVD3C pool, Philips introduced a per-batch licensing system. This implies a license per shipment of products of DVD discs and player products, rather than for all products sold over a set number of years. The system directly tied the licensee’s legal right to use patented technology to the payment of royalties.

**Blu-ray**

Shortly after the market introduction of DVD, Sony, Philips, and Panasonic initiated the development of Blu-ray, a next generation platform. They were quick to get other major consumer electronics companies on board such as Samsung, Pioneer, LG, Sharp, Hitachi, Mitsubishi, and Thomson. The competing platform, HD-DVD, was developed by Toshiba, NEC, and Sanyo. Blu-ray emerged victorious after most of the major film studios and major retailers announced exclusive support for the platform early 2008. In the competition between Blu-ray and HD-DVD, the importance of winning support from providers of complementary products (film studios) was greater than in previous platform competitions. The Blu-ray platform sponsors attracted more support than HD-DVD by
acknowledging the preferences of the film studios. For example, they incorpo-
rated certain audio and video compression standards and content protection tech-
nologies in the platform. Some of these technologies were covered by the IPR of 
complementary product providers, and these had different incentives for monetizi-
ing IPR than the major consumer electronics companies.

Sony, Panasonic, and Philips started discussions for setting up a patent pool in 
September 2005, almost a year before market introduction of the first Blu-ray 
players and discs. By the end of 2009, Sony, Panasonic, Philips, CyberLink, and 
Hitachi issued a public patent call. By August 2011, the One-Blue patent pool 
was launched. The sponsors of the HD-DVD platform had incurred severe losses 
and were not ready to join One-Blue. Toshiba set up a competing patent pool, 
Premier BD, with Warner, Mitsubishi, and Thomson.

In setting up the One-Blue patent pool, Blu-ray’s main platform sponsors set 
out to prevent non-paying licensees, and encourage platform implementers to 
become licensees. Their approach was to limit IPR fragmentation and make life 
easier for licensees. They decided to go beyond a “DVD” type of patent pool 
and aimed to create a pool for all the patents required to implement the Blu-
ray platform (i.e., including patents required for CD and DVD because Blu-ray 
was backwards compatible to these platforms), thereby reducing total royalties and 
transaction costs. As Figure 3 shows, One-Blue’s founders managed to pool their pat-
ents on Blu-ray, most of the DVD patents, and CD. The pool also included patents 
required for DVD-R, -RW, +R, +RW, and CD-R, which were required for Blu-ray

**FIGURE 3.** Non-Exhaustive Overview of Licenses Required to Manufacture a CD, DVD, or Blu-ray Player (packages with dotted lines represent additional licenses required for recorders)
recorders. They also tried to include patents regarding some externally developed compatibility standards, but these efforts did not bear fruit.

In October 2009, the founders of One-Blue established a separate legal entity, One-Blue LLC, as independent pool administrator with the sole task to act in the interest of the pool. The founders wanted to avoid the problems experienced in previous patent pools whereby one of the IPR owners regulated licensing and enforcement. When one of the IPR owners acts as pool administrator, it may need to deal with the backfire of enforcing the patents in the pool, hindering its capacity to operate effectively. An independent pool administrator has two main advantages: it mitigates the possibility or illusion of a conflict of interest, and the pool’s stakeholders are better able to monitor the performance of the administrator and hold it accountable.

One of the key issues was to allocate the royalties over the optical disc formats in the pool. The companies agreed on a fixed allocation, which is adjusted over time to account for shifts in the number of patents in the patent packages related to the different optical disc formats. Considering that the DVD format was introduced in the market in 1997, and patents have a maximum lifetime of 20 years, one can imagine the shift in allocation that will occur in the coming years.

While Philips, Sony, and Panasonic were setting up the patent pool, they held discussions with potential licensees to understand their views and expectations. They learned that a key requirement for these potential licensees was a true level playing field whereby the pool would ensure that all participants in the market would take licenses and pay all royalties due. To achieve this, One-Blue had to find a way to protect licensees and licensors from companies that failed to pay royalties, and to be effective in engaging non-licensees. They decided to re-use the per-batch licensing system that was introduced for DVD discs for all Blu-ray products. In order to avoid unnecessary cost, the pool initiators applied a pre-netting principle, whereby licensees only paid their net royalties to the licensors in the patent pool. The existing bilateral agreements between licensors and licensees and the related royalty payments are taken into account when calculating payments. Regarding the enforcement of patent rights, One-Blue applied mandatory participation in enforcement action. This was a response to the serious free rider problem in the existing patent pools, like MPEG-2 video, resulting from the voluntary participation in enforcement actions. The members of One-Blue agreed that each licensor would make its patents available for use when One-Blue decided an enforcement action was warranted.

In One-Blue, the licensors moved away from the conventional and easy “one patent one dollar” approach of valuing patents, because it encouraged companies to apply for a high number of separate essential patents per invention. The only brake on this “patents race” is the cost of filing and maintaining a patent. As long as these costs are lower than the income of an extra patent in the pool, a company has an incentive to file an extra divisional or continuation patent. However, if all patent owners adopt this tactic, everyone has higher costs. To stop this undesired practice, the founders of One-Blue decided they would limit the number of divisionals or continuations for each parent patent. In addition, One-Blue differentiated the value of the patent based on the nature of its invention. Physical
format patents were given more weight than application format patents, because physical format inventions require more costly research and are used in products all the time.

While the One-Blue patent pool was established fairly recently, the number of licensors quickly grew to 15 (including the major contributors to the Blu-ray platform) and contains a large majority of all Blu-ray essential patents. As Table 1 shows, the number of licensees has grown to 50, and this rapid growth shows that the license conditions are considered appealing. This is not surprising when we consider the pricing and the efficiency that One-Blue offers over bi-lateral licenses. As Table 2 shows, the cumulative amount of separate licenses required to manufacture Blu-ray players is roughly $25, whereas One-Blue offers the license at $9. This constitutes a differential saving of 64%.

### The Evolution towards a “Pool-of-Pools”

Based on the three generations of optical disc patent pools, we can distinguish three types of pools (as shown in Figure 4). The evolution of these patent pools was influenced by two factors; the number of parties involved in co-creating the technology, and the complexity of the technology platform. In order to cope with the increased number of parties involved in platform development and the increased platform complexity, the patent pools became more sophisticated and evolved towards the novel pool-of-pools.

In a Joint Licensing Program (JLP), a few parties combine their patents and offer them to licensees at predetermined rates. JLPs are a relatively quick and cost-effective means of collaboration, and they are often administered by the party that is the most experienced in licensing. A JLP is especially suitable when few parties are involved in the development of the technology and it has low complexity. This is often the case when a radical innovation disrupts the industry. JLPs are seldom open to new members.

### TABLE 2. Estimated Fees for Bi-lateral Licenses on a Blu-ray Player, instead of a License from One-Blue

<table>
<thead>
<tr>
<th>Licenses included in One-Blue</th>
<th>Comparable Fees for Bi-lateral licenses</th>
</tr>
</thead>
<tbody>
<tr>
<td>CD</td>
<td>&lt;$1</td>
</tr>
<tr>
<td>DVD 3C pool</td>
<td>$5</td>
</tr>
<tr>
<td>DVD 6C pool&lt;sup&gt;a&lt;/sup&gt;</td>
<td>$2</td>
</tr>
<tr>
<td>Blu-ray</td>
<td>$17.25 (Philips $3.50, Sony $2.25, others $11.50)</td>
</tr>
<tr>
<td>Total per Blu-ray player</td>
<td>$25</td>
</tr>
</tbody>
</table>

<sup>a</sup> about 50% of the necessary patents for the DVD 6C pool is included in the One-Blue license, remaining patents have to be licensed in addition.

*** Information regarding license fees of Philips and Sony has been retrieved from their websites (e.g., <https://www.ip.philips.com/services/>). We made an estimate on the cumulative bi-lateral Blu-ray player licenses of the other patent holders that participate in One-Blue. In order to derive this estimate, we accumulated Philips and Sony’s license fees for Blu-ray players, and since the other parties have twice the number of essential patents, we estimated that they would cumulatively charge twice as much compared to Philips and Sony.
**Figure 4.** Three Patent Pool Models, Typical Features, and Factors Influencing the Choice of Patent Pools

“*Regular*” Patent Pools are the most widely used type of patent pools.27 This model is based on the MPEG-2 patent pool, which was the first modern patent pool to receive a comfort letter from the antitrust authorities and became very successful.28 This model is a suitable solution when multiple parties are involved in technology co-creation and are willing to collaborate in a joint license.

The novel “pool-of-pools” is the most sophisticated. It aims to facilitate the market adoption of complex products. This pool may encompass the patents of multiple generations of technology. Due to the large number of players involved in the co-creation, the success of this type of pool depends to a large extent on the willingness to collaborate. Compared to the other patent pools, the pool-of-pools has high negotiating cost and takes several years to become operational.

**Designing and Managing Patent Pools**

Based on our observations, we have found that the lifecycle of patent pools passes through four phases: investigation, formation, gaining traction, and maturity (Figure 5). Each phase involves several activities that contribute to the success of a patent pool.

**Phase 1: Investigation**

The lifecycle of a patent pool starts when a company takes the initiative to determine the scope of the pool and drives the process. The initiator can be one of the patent holders, a professional license administrator, or a Standard Development Group.
Organization. In the case of the optical disc patent pools, the initiators were major patent holders that could provide the pool with the required critical mass. The scope is defined by the pool’s mission and goals. Whereas patent pools in the field of consumer electronics and telecommunication generally aim to facilitate worldwide market adoption of a technology and to appropriate license income, patent pools in the field of agriculture and healthcare often serve a humanitarian goal by aggregating IPR on medicines or seeds and licensing this on royalty-free basis in developing countries. The next step is to determine the patent packages that will be offered by the patent pool. The CD pool offered a package for CD-discs and for CD-players, whereas the Librassay pool offers many packages divided over eleven categories. The last consideration is the type of patent pool (joint licensing program, regular patent pool, or pool-of-pools), which has been discussed above.

When the initiator starts investigating which parties have a common interest to establish a patent pool, one can initially take an “open” approach by extending a call to any party that may own an essential patent, or a “closed” approach by selecting a few major patent holders. To simplify negotiations and minimize associated costs, the initial groups that started the optical disc patent pools consisted of up to six major patent holders. Whereas both an open and a closed approach can work, the latter has most benefit when the group of patent holders is large and diverse, as is usually the case when creating a pool-of-pools. For efficient follow-up discussions, it helps to establish a homogeneous group of companies, however the optical disc patent pools show there can be exceptions.

**Phase 2: Formation**

In the formation process, the initial group has to determine whether the patent pool will be administered by one of the members, whether a new entity will collaboratively be established for this purpose, or to outsource this task to an established commercial license administrator. For inexperienced parties, it...
can be helpful to enlist the services of a commercial license administrator to provide support in establishing a patent pool. When aiming to establish a regular patent pool or a pool-of-pools, the best practice from the optical disc industry is to let an independent license administrator manage the pool.

The next step is to determine the charter of the patent pool. Table 3 shows the charter’s main parameters, considerations per parameter and associated lessons learned from the optical disc patent pools.

Once the charter has been defined, the group can issue a call for patents, inviting other patent holders to join. Interested parties submit the patents that they deem essential to an independent patent evaluator. The group with essential patents may consider requesting a comfort letter from the antitrust authorities. This is recommended when the patent pool is expected to meet scrutiny from antitrust authorities.

### Phase 3: Gaining Traction

After a patent pool has started, access to licenses is open and non-discriminatory, and it is important to create public transparency by making license rates and terms, licensors, licensees, and the respective patents in the pool publicly available. The next step is to actively market the license, e.g., by visiting potential licensees and identifying parties that sell products based on the technology platform.

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<tbody>
<tr>
<td><strong>Main Parameter</strong></td>
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<tr>
<td>Pricing / License Fees</td>
</tr>
<tr>
<td>Royalty Collection</td>
</tr>
<tr>
<td>Royalty Allocation</td>
</tr>
<tr>
<td>IPR Enforcement</td>
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</tbody>
</table>
To prevent unauthorized use of the patents in the pool, the administrator will have to enforce the patent rights.

While the patent pool is gaining traction, other patent holders may want to join. This requires an on-going process of patent evaluation and recalibration of the royalty allocation. To deal with these changes and the various other aspects, a patent pool may hold regular administrative committee meetings where all licensors are invited to discuss ongoing business.

**Phase 4: Maturity**

In the maturity phase, the pool administrator will need to enforce contractual compliance by auditing its licensees. As patents are often granted for a period of twenty years, the pool administrator will need to monitor the expiration of patents and the countries in which they expire, recalibrate the royalty allocation, and possibly adjust the license fees.

**Discussion and Conclusion**

For modern technologies, access to IPR is often complex and sometimes problematic because it is fragmented among many owners. The bilateral licensing agreements that need to be concluded are time consuming, invoke considerable transaction costs, and can result in royalty stacking. Often it is in the interest of the technology sponsor to ease access to the required IPR, whether owned by the sponsor or by other parties that are willing to cooperate. In the optical disc industry, patent pools have proven to be a useful way to achieve this goal. Over time, these patent pools have become more sophisticated. The small, relatively simple, and closed Joint Licensing Program was succeeded by Regular Patent Pools that catered to a larger number of pool members and licensees. The latest development is the “pool-of-pools,” which addresses the increasingly occurring situation in which consumers demand devices that not only support a new technology, but also previous generation technologies.

Though our analysis has thus far been focusing on the optical disc industry, pools and pool formation (using the process described in Figure 5) can be equally well applied to other platform and standards-based industries that face patent thickets, e.g., radio, television, telecommunications, computers, and automotive. Pools are now being established in industries where technology platforms and compatibility standards are less prominent, such as in agriculture, pharmaceutics, and healthcare. The use of the novel pool-of-pools model is likely to be appealing specifically to industries with complex products that incorporate several technology generations. For instance, the IEEE 802.11 standard (popularly known as Wi-Fi) has developed through as much as six generations, and devices usually incorporate several (if not all) of these generations. Currently, there is a modestly successful patent pool for the first three generations of this standard, and recently an initiative was started for a separate pool that covers the latest generations. Instead, the pool-of-pools model could be used as reference for a one-stop-shop of all generations. In the computer industry, the Ethernet standard (IEEE 802.3) and the related Power over Ethernet standard (IEEE 802.3af) also involve multiple technology generations and a patent thicket. Arguably, industries such as mobile telecommunications could also
make a sensible case for pools of pools, because typical modern phones incorporate at least two or three technology generations. While earlier attempts to create pools in this industry have met only moderate success, multiple new pool initiatives have been taken for the latest technology generation in that field, called 4G LTE.

As noted earlier, there are several trends that make it increasingly difficult for companies to navigate through the patent thicket. This will foster the adoption of future pools, as well as pools-of-pools, even in industries where this has been difficult. The first trend is the rapid growth in research and development expenditures, patenting intensity, and the typical number and diversity of patent holders for any specific technology. The second trend is increased convergence of functionalities into devices and products. Whereas traditional technologies could often be exploited as a device or service in its own rights, today’s devices often incorporate many different technologies. The third trend is the increasing use of IT and telecommunications standards as enabling technologies in larger systems including smart grids, logistics and transportation, personal health, and the “internet-of-things,” to name a few. As result of these three trends, many of tomorrow’s markets will have to deal with a more diverse and more fragmented IPR market, both in terms of sellers (patent owners) and buyers (technology implementers). This increases transaction costs and renders current practices of bi-lateral or cross licensing increasingly ineffective. Patent pools will be more and more recognized as an attractive model to facilitate these IPR markets, benefiting technology developers and technology implementers alike.

Notes

1. Some of the product names referred to in this paper are copyrighted or have registered trademarks, such as Android™, Windows Mobile®, and Librassay®.
5. DVD players also use several compatibility standards (connectors and signals) in order to be interoperable with a variety of televisions.
6. The Golden Rice pool is a patent pool of six licensors, led by Syngenta, that have pooled 70 patents to provide licenses for a genetically engineered strain of rice.
7. Librassay is a service that is provided by MPEG LA and functions as a “patent licensing supermarket,” aggregating diagnostic and discovery patent rights.


17. This number is derived from the AT&T website, <www.att.com/gen/sites/ipsales?pid=19116>.

18. This number is derived from the AVC pool license administrator website, <www.mpegla.com/main/programs/AVC/Pages/Licensees.aspx>.

19. Lerner and Tirole, op. cit.


26. They achieve this by filing as many divisional or continuation patents as possible for one invention covered by a parent patent.

27. Out of the 32 patent pools in Figure 1, 27 are “Regular” patent pools.

29. There are several professional license administrators, of which MPEG LA, SISVEL, Via Licensing, and SIPRO LAB are the most prominent.

30. An overview of independent patent evaluators can be found on the One-Blue website: <www.one-blue.com/patent-evaluation>.

31. More precisely, the term "Wi-Fi" refers to the certain categories of IEEE 802.11-based products that successfully passed the certification program of the Wi-Fi Alliance.


33. In late 2012, two patent pools for LTE products went operational, administered by Via Licensing and SISVEL respectively.