# Open Source Licensing

**JANET HOPE**, *Project Director, Co-operative Intellectual Property Management, Centre for Governance of Knowledge and Development, Research School of Social Sciences, Australian National University, Australia*

## ABSTRACT

This chapter provides an introduction to open source software licensing. The chapter seeks to demystify the concept of open source so that intellectual property (IP) owners and managers can decide whether an open source approach is worth pursuing. The chapter explains the principles of free and open source software licensing and outlines the decisions that an innovator must make when deciding which strategy to use for developing a new innovation. Also explained are the differences between open source and public domain, and between the uses of the terms copyleft and academic to describe open source licenses, as well as the incentives (financial and otherwise) for open source licensing. Finally, the author identifies important considerations regarding the possibilities for open source licensing in fields other than software development, particularly biomedicine and agricultural biotechnology.

## 1. INTRODUCTION

Open source software has had remarkable technological and commercial success. Since the late 1990s, many people have been interested in applying the principles of open source to other fields, including biomedicine and agriculture.

The term *open source* is sometimes used very broadly to mean any approach to intellectual asset management that entails a higher level of transparency, or greater access to information, than is usual in a proprietary setting. This broad use of the term is of little value to IP managers because it is too imprecise.

In fact, the only context in which the term *open source* has a generally accepted definition is in software development.[1] This chapter uses the term in as far as possible the same sense as it is used in the software context but suggests that the underlying IP management approach could be applied in other contexts.

Conventional software development is sometimes termed *cathedral building* because it proceeds according to the hierarchical directions of one or more software architects (the word *architect* is derived from words meaning "chief builder"). Conventional software is usually protected through IP rights, as a strategy to exclude some or all prospective users of the technology.

By contrast, open source software development projects, such as those that produced Linux, Apache, and BIND, are decentralized and self-organized. Open source software development is an evolutionary process: the contributions of self-selected project participants are subjected to trial-and-error testing in diverse use environments, and the resulting information influences further development. This mode of production has been termed "the bazaar" and is also known as *collective* or *commons-based peer production*.[2]

In order for open source software development to work, would-be users and developers must be authorized to access the source code. In

Hope J. 2007. Open Source Licensing. In *Intellectual Property Management in Health and Agricultural Innovation: A Handbook of Best Practices* (eds. A Krattiger, RT Mahoney, L Nelsen, et al.). MIHR: Oxford, U.K., and PIPRA: Davis, U.S.A. Available online at www.ipHandbook.org.

the conventional "proprietary" approach to software development, source code is not freely available for two reasons: (1) source code is treated as a trade secret and (2) the original expression contained in a program's source code is subject to copyright protection. To enable open source development, therefore, the software owner must (1) refrain from keeping the source code secret and (2) grant an IP license to others so that they have the legal right to access and manipulate copyright-protected aspects of the code.

Open source licensing should not, in theory, pose any antitrust problem (at least in jurisdictions where the relevant test takes into account substantive effects on competition), because its effects are fundamentally pro-competitive.[3]

## 2. WHAT IS *OPEN SOURCE*?

### 2.1 *The open source definition (OSD)*

An open source software license is one that conforms to the latest version of the open source definition (OSD), published on the Web site of the Open Source Initiative (OSI), a nonprofit corporation established in 1998 by a small group of programmers who wanted to promote the wider adoption of open source licenses.[4] Licenses that conform to the OSD are permitted to carry a registered certification mark.

A summary of the requirements of the OSD is that in order for a software license to be open source, licensees must be free 1) to use the software for any purpose whatsoever; 2) to make copies and distribute them without paying royalties to the licensor; 3) to prepare derivative works and distribute them, also without payment of royalties; 4) to access and use the source code; and 5) to use the open source software in combination with other software, including proprietary (that is, non-open source) software.[5] An open source license may not restrict the number of products a licensee is allowed to distribute, the identity or geographic location of the recipients, or the price the licensee asks them to pay. Optionally, these same guidelines may be stipulated to apply to certain improvements or other downstream uses of the original software.

The OSD's definition could be summed up even more concisely: in open source software licensing, anyone, anywhere, and for any purpose must be allowed to copy, modify, and distribute the software (either for free or for a fee) and, therefore, must be allowed full access to the software's source code.[6]

### 2.2 *The free software definition (FSD)*

The OSI is not the only de facto standard-setting body in the field of free and open source software licensing. Others include the Free Software Foundation (FSF)[7] and the Debian Linux community[8].

According to the FSF's Free Software Definition (FSD), software "freedom" is the freedom to use, copy, study, modify and redistribute both modified and unmodified copies of software programs, all without having to pay for or otherwise obtain specific permission. To give practical effect to this freedom the licensor must allow users access to the software's source code.[9]

Clearly, the FSD is very similar to the OSD. There are ongoing debates about the differences between what constitutes free software and open source software, but in fact the two are virtually identical: with very few exceptions, free software conforms to the OSD, and open source software conforms to the FSD.[10]

## 3. THE PROCESS OF DEVELOPING A LICENSING STRATEGY

Open source licensing is just one kind of IP strategy. Figure 1 depicts the process of choosing which licensing strategies (if any) to use.

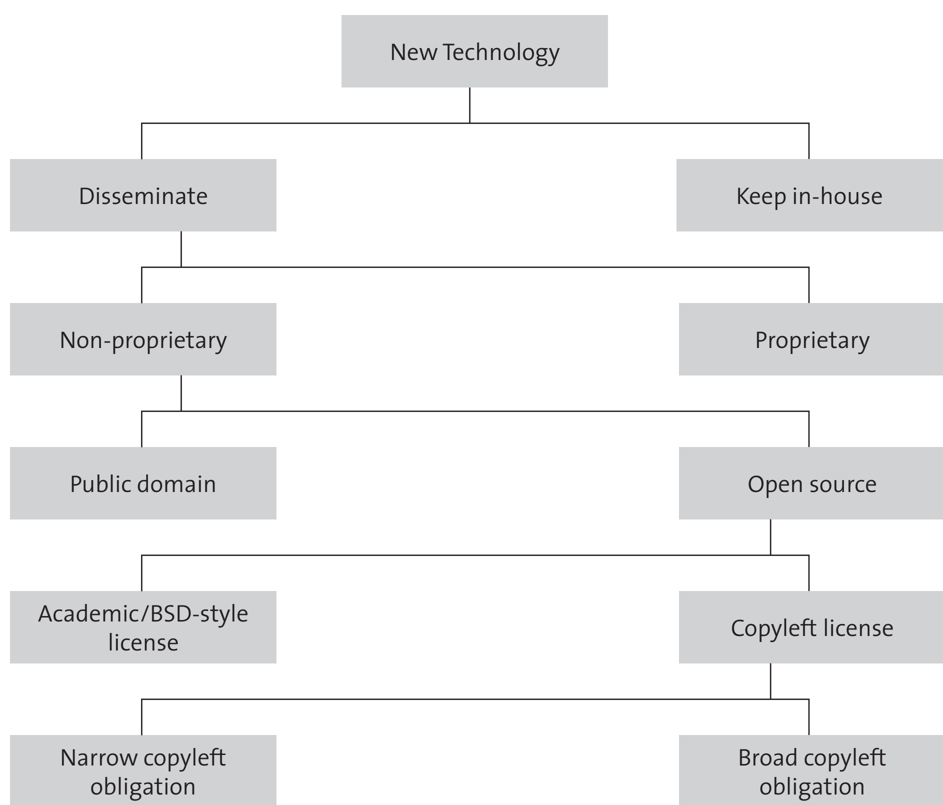
The first thing to do when formulating an appropriate strategy for exploiting new technology is to make a careful cost-benefit analysis of all the possible avenues for development.

This analysis will require certain considerations:

- **The first decision**. If the technology is to be disseminated rather than kept in-house, resources must be committed to marketing the technology, demonstrating and improving its usefulness, and establishing it within extended research and development networks.[11]

- **The second decision**. If an innovator decides to disseminate the technology, it is not always advantageous for him or her to restrict public access to it. Sometimes, an innovation can be freely offered to the public and still generate at least as much economic advantage for the innovator as would a proprietary strategy. Nonproprietary strategies can be more advantageous to the research community, society as a whole, and the innovator. Open source licensing generally creates fewer transaction costs and is inherently more transparent than a proprietary licensing strategy. The decision to follow a nonproprietary strategy does not have to be born out of altruism or ideology: it can instead be born out of healthy self-interest.
- **The third decision**. If an innovator decides on a nonproprietary strategy, the innovation can be licensed on an open source basis or placed in the public domain: that is, the innovator can refrain from obtaining any IP or other property rights at all. Licensing an innovation is costly and time-consuming and should be considered only if there is good reason to obtain or retain ownership of the technology.
- **The fourth decision**. After choosing an open source approach, an innovator must choose between an academic open source license and a copyleft-style license (both terms are defined in a later section). If the

**Figure 1: Decision Tree to Determine the Type of License**



main objective is to encourage widespread adoption of the technology in its current state, the more permissive academic license is likely to be preferable. If the main objective is to guarantee access for the innovator or others to improved versions of the technology, or to other innovations built upon it, a copyleft-style license is worth considering.

- **The fifth decision**. If the innovator decides on a copyleft-style license, the final decision must be how broad or narrow the copyright obligation is to be. The narrowness or broadness of a copyright obligation may be thought of as the reach of the copyleft "hook." Although the diagram depicts this decision as a binary one, in fact, possible formulations of copyleft obligations form a spectrum. The reach of the copyright hook should be dictated by the licensor's assessment of prospective licensees' incentives to contribute to ongoing development.

This remainder of this chapter will explore the nonproprietary options that are available to the innovator, with a special emphasis on the various types of open source licensing.

## 4. OPEN SOURCE VERSUS PUBLIC DOMAIN

Once an innovator has decided to disseminate his or her technology in a nonproprietary fashion, he or she must decide between open source licensing and placing the innovation in the public domain (also known as straightforward publication): that is, foregoing IP protection altogether.

### 4.1 *The advantages of public domain over open source*

The primary advantage of straightforward publication or dissemination of a new technology over an open source approach is that it does not require the innovator to obtain or maintain IP protection. Depending on the type of IP right, protecting IP can be costly in terms of time and resources. It also has the disadvantage of contributing to the proliferation of IP rights.

In some contexts, claiming ownership over an innovation may also create a negative effect with respect to ongoing collaborations. It may create ill will among prospective users and decrease the chances that a technology will be widely adopted or improved. Such negative effects are especially likely when the ownership claim is particularly broad (as in the case of the non-coding DNA sequence patents or junk DNA)[12] or when user-developers have a strong belief that the technology ought to be in the public domain (as in the case of human genome project sequence data).[13]

### 4.2 *The advantages of open source over public domain*

There are several circumstances in which an open source strategy might have advantages over a public domain approach as a way of encouraging the widespread adoption and ongoing development of an innovation.

One situation in which an open source approach may be useful is where inventors have automatic ownership rights over some part of the relevant technology. Some biological innovations incorporate tangible material components (such as cell lines or germplasm) that are owned by the inventor regardless of whether active efforts are made to protect the innovation. Similarly, software programs, data, or written protocols that are incorporated into biological innovations are automatically subject to copyright protection provided they meet statutory criteria. In such cases, a license may help to reduce the transaction costs of transferring the technology to other prospective users because the license clarifies the owner's intention to make the technology available on open source terms. (This is analogous to Creative Commons' objective of facilitating the dissemination of cultural material by helping copyright owners to specify which rights are reserved.)[14]

A second situation in which an open source license may be preferable to straightforward publication from the perspective of the innovator is a situation in which there is a proliferation of overlapping IP rights or the field of innovation is especially competitive or litigious. While even an open source license has the drawback of adding to the complexity of the IP landscape, failure to assert ownership over a technology before making it available for public use sometimes means that someone else can patent the technology and pursue a proprietary exploitation strategy to the detriment of the innovator and other potential users. In this case, patenting followed by open source licensing of an innovation is a form of defensive disclosure that may be more reliable than other defensive disclosure mechanisms as a means of protecting against subsequent patent claims.

Third, IP ownership gives an innovator the right to set terms of use and exclude anyone who will not abide by those terms. For example, in a copyleft-style arrangement, follow-on innovators must make some improvements available to others on the same liberal terms as the initial innovation was made available to them. Another example is the litigation deterrent clause found in many licenses (both open source and proprietary), which terminates the licensee's rights if he or she sues the licensor (for example, for infringement of one of the licensee's patents).

Finally, IP rights may facilitate certain pathways to development even if they are licensed on open source terms. The existence of IP protection signals to potential investors that the innovator is disciplined and has financial backing and that the innovation is worth supporting.

### 4.3 *Combining proprietary licensing, open source, and public domain*

There is nothing to stop an open source licensor from offering a technology under both proprietary and open source licenses. This approach, known as dual licensing, generates a surprising amount of income for many open source software programmers, some of whose customers prefer, and are willing to pay for, a more conventional licensing arrangement. Thus, the commercial application of an open source license does leave some room for recovery of the costs of protecting the relevant IP.

It is possible to adopt a nonproprietary strategy at a relatively late stage in an innovation's life cycle, perhaps when the amount of proprietary licensing revenue the innovation generates begins to decline. In this case, granting an open source license to the innovation may be a sensible alternative to abandoning the patent altogether. In such circumstances the full cost of obtaining and maintaining IP protection has little bearing on the decision to go open source, because the majority of these costs have already been incurred.

## 5. INCENTIVES FOR OPEN SOURCE DEVELOPMENT

Why would any rational, self-interested IP owner decide to adopt an open source license? Many people think of open source licensing as an altruistic exercise, or alternatively, as a strategy pursued for the sake of purely personal rewards, such as fun or a sense of belonging to a community. This is an unnecessarily limited view.

### 5.1 *Direct financial incentives*

An open source license must permit the sharing and distribution of the technology without charging any royalty. In this context, a royalty is any ongoing payment that is linked to the use of the technology (for example, a percentage of profits on products generated using a technology, or a regular payment whose amount depends on the number of people who are given access to the technology), not a one-time payment. Therefore, although open source licensors cannot charge royalties, they can charge a one-time fee that is as high as the market will bear.[15]

Of course, the fact that an open source software license must guarantee its licensees' freedom to make copies of the licensed software and distribute them to others without having to make additional payments to the licensor means that the price of the technology tends to be driven down to the marginal cost of reproduction and distribution—for software, close to zero. Keep in mind that while the inexpensiveness of open source software *production* relative to conventional proprietary production is an inherent feature of the open source model, the low price of open source software to consumers (and hence the low rate of return to licensors in the form of license fees) is a consequence of market forces that may not exist with respect to other types of technology. For example, because the marginal cost of reproduction and distribution may be quite high for technologies that are less highly codified than software or are embedded in tangible objects the production costs of which are sensitive to economies of scale, fewer distributors may come forward to compete with the original licensor, and licensees may be more willing to pay the licensor for extra "copies" of the technology than is the case in the software context.[16] This means that there may be more opportunities for a licensor to profit directly from the sale of non-software open source technologies.

### 5.2 *Indirect financial incentives*

Most of the incentives for open source licensing are indirect rather than direct. Sections 4.3 and 4.4 describe incentives relating to cost savings, productivity gains, and reputational capital. However, one of the most important effects of open source licensing is to expand the user base for a technology, thereby expanding the market for complementary goods and services.

There are several reasons why an open source license tends to increase user numbers. In the first place, a technology that is distributed according to open source terms is often more attractive to users because it is more affordable and available than its proprietary counterparts and because its availability is not dependent on any particular supply chain.

Next, open source technology is *malleable*. Licensees can make modifications to the technology and access the means for doing so. The malleable nature of the technology creates markets not just for the technology itself, but also for associated maintenance services, upgrades, and adjustments.

These market-expanding effects are especially pronounced for technologies with strong *network effects* (that is, technologies that become more valuable as more people adopt them, which in turn increases their popularity): this includes not only information and communication technologies but also many biomedical and agricultural technologies. For example, a microarray reader that displays data in a particular format becomes more useful if a number of scientists use the same reader: the uniformity of data output makes it easier to compare and verify data that originated in many different laboratories.

As the market expands, revenues from sales, one-off licenses, and dual licensing may be enough to offset the opportunity cost of adopting a nonproprietary licensing strategy. At the same time, the demand will increase for complementary products and services, including technology training, technical support, customization services, hardware or wetware supplies, proprietary data-analysis software, and so on. Many successful commercial open source software ventures turn a profit by providing complementary products and services. Perhaps the most striking example is that of IBM: a substantial investment in open source software production provides IBM with access to a better operating system that makes its primary commercial offering, server hardware, more valuable to consumers.

### 5.3 *Non-financial incentives for individual researchers*

Computer programmers are often motivated to contribute to open source software development by incentives that are not strictly monetary (though they can be translated into monetary rewards in the employment market): the possibility of enhanced personal reputation and the opportunity to learn new skills.[17]

At first glance, such nonmonetary benefits may seem irrelevant to the biomedical or agriculture fields, where decisions about research investments are commonly made at an institutional rather than an individual level. However, individual researchers in both of these fields can decide, to some extent, how and where they will direct their own or their laboratory's resources. Such self-determination is common for academic researchers, but is also evident in biotechnology and pharmaceutical companies, many of which allow staff to spend some designated fraction of their time on personal research projects in order to encourage creativity, increase job satisfaction, and, it is hoped, generate new commercial opportunities for the company.[18] Researchers with some creative freedom might decide to participate in open source development under appropriate funding and employment conditions. The same is true for the many open source software developers who are not hobbyists but, instead, professionals whose contributions form part of their employment.[19]

### 5.4 *Institutional incentives*

#### 5.4.1 *Intrainstitutional incentives*

It is to an organization's advantage to build a reputation for cutting-edge technological innovation, and to keep its researchers sharp by allowing them to participate in a range of projects, regardless of their projected commercial value. Furthermore, open source development encourages the development of a productive, collaborative environment.

#### 5.4.2 *Interinstitutional incentives*

In both biomedicine and agriculture, the locus of innovation is often not the individual company or university but the network of diverse collaborations among organizations.[20] Open source licensing offers a way of sharing the costs and risk of technology development among many prospective users: in other words, open source development can be a form of precompetitive collaboration. As users and developers collaborate on a project, technological applications multiply and diversify, and robust and reliable tools are created. Bruce Perens, author of the OSD, points out that the same groups of companies often have a low rate of success of proprietary consortium software development but a high rate of success with large open source projects; he suggests that the inherent fairness of open source licensing encourages effective collaboration between parties with different interests.[21]

Open source licensing is not primarily a means of dealing with existing "anticommons tragedies," that is, bargaining failures among owners of multiple complementary IP assets.[22] Unless the technology in question is a killer app—a software term for any tool that renders obsolete all others in its class—the terms on which it is licensed, whether open source or otherwise, can have little impact on existing reach throughs, royalty-stacking provisions, and other restrictive licensing terms. Rather, open source is a means of pre-empting such tragedies by establishing a robust commons for basic or fundamental technologies whose value is likely to be enhanced by cumulative innovation. In situations where an anticommons problem already exists, nonproprietary strategies can have a beneficial tipping effect, because the greater the number of nonproprietary tools in any given tool kit, the greater the incentive of everyone in the field to invest in developing substitutes for the remaining proprietary technologies for the sake of achieving freedom to operate with the tool kit as a whole.

## 6. DIFFERENT TYPES OF OPEN SOURCE LICENSES

### 6.1 *Copyleft licenses*

A *copyleft*, or *reciprocal*, license allows the user to modify and redistribute a software program at will. The licensee's obligation under a copyleft license is to make relevant downstream technologies available to all comers (including the original licensor) under the same terms as provided by the original license. No one (including the original licensor and his or her licensees) obtains any special privilege regarding any next-generation technology, such as a right to preview any improvements or exclusive sublicensing rights to any improvements. The point of a copyleft license is to create an ever-growing pool of downstream innovations that remain freely accessible to all comers.[23]

However, a copyleft license is not always the best way for innovators to guarantee themselves access to future improvements in the technology. Instead, prospective licensors should carefully consider how they can best encourage licensees to contribute to a technology commons.

When deciding whether or not to use a copyleft license, the innovator should take into account the attitudes, needs, and constraints of prospective users, as well as the other tools that they are likely to use in conjunction with the technology. For example, if licensees use tools that are subject to proprietary intellectual property licenses, the conditions imposed by owners of that intellectual property may conflict with the copyleft obligation to make downstream innovations freely available. Furthermore, it is possible to trigger a cycle of cumulative innovation even if users do not perfectly comply with the copyleft ideal, provided there is a critical mass of user-developers who do.

A copyleft-style obligation is probably necessary only if potential contributors are likely to be seriously put off by the existence of free riders, those who let others put in the time and money for research and development and then help themselves to the results. Even then, an innovator should take care to explain to his or her licensees why such an obligation is necessary. Under no circumstances should an open source license restrict licensees' freedom to take development in new directions, with or without the licensor's approval. The strength of open source is, after all, its ability to harness the creativity of diverse user-contributors who are allowed to work in relative freedom.

If it is decided to adopt a copyleft license, the licensor has two main ways of tailoring the license terms to maximize the incentives of prospective contributors. Not every modification, improvement, or new application of a technology that has been licensed on copyleft terms must be made available on those same terms. In the first place, only derivative works that are externally deployed—that is, sold or otherwise distributed outside the boundaries of the licensee's organization—are subject to the reciprocal obligation under a copyleft license.

Second, even if a downstream innovation is externally deployed, it still may not fall within the definition of improvements in a particular copyleft license, because different licenses have broader or narrower definitions. The only real check on the licensor's discretion with respect to the breadth of this definition, apart from the willingness of other contributors to accept the license terms, is the scope of the licensed intellectual property. A licensor who seeks to control that which he or she does not own may run afoul of competition laws.

In this connection, a trap for would-be copyleft-style licensors to be aware of is that an open source license must grant the licensee the freedom to create a new collaborative-development project based on previous contributions (a phenomenon known in the software industry as a code fork), for any reason at all.[24] The possibility of forking means that technologies can still be improved even if their initial innovators have lost interest in the technologies or have lost the capability to develop them. In practice, forking is rare, largely because it is difficult to persuade others to abandon the old project in order to start on a new one. It is often easier for dissenters to continue working on the original project and then invest some of their own resources adapting its output to their specific needs rather than abandon the original project altogether. However, in formulating the definition of improvements in a copyleft license, the licensor (or his or her agent) must avoid restricting the freedom to fork development.

Thus, the two most important aspects of a copyleft-style license are: (1) the definition of "improvements" (or an equivalent term) which determines which follow-on innovations must be licensed on the same terms as the initial licensed innovation; and (2) the definition of "external deployment" (or equivalent), which determines under which circumstances the aforementioned obligation must be fulfilled. These may be adjusted by the licensor to create a copyleft license that strikes the appropriate balance of incentives to contribute to any given project.

### 6.2 *Academic licenses*

Another type of open source license is the academic or BSD-style license (named after the Berkeley software distribution license, the oldest license in the OSI's list of approved licenses). These licenses do not require users to make externally deployed improvements available to the licensor on the same terms as the original technology; in some cases, the downstream user's only obligation is that he or she must give the innovator credit for the innovation. According to Larry Rosen, the difference between copyleft and academic open source licenses is that the former are employed by generous sharers of IP freedoms, whereas the latter are employed by generous donors of IP freedoms.[25]

An academic license can achieve some of the goals of open source as effectively as can a copyleft license. Indeed, where the licensor's primary goal is to encourage widespread adoption of the initial innovation, an academic-style license may be more effective because a copyleft license could deter potential licensees who want to be able to commercialize their own improvements on a proprietary basis.

## 7. OPEN SOURCE IN FIELDS OTHER THAN SOFTWARE

Although most of the examples given here come from the software industry, the principles of open source can be applied to other fields as well. Open source technology could be especially useful in niche markets that are too small to be profitable for companies that make off-the-shelf, proprietary technologies. Importantly, open source technologies can be tailored to serve small agricultural and pharmaceutical markets in developing countries (where *small* may refer either to the numbers of potential users or the amount that potential users can afford to pay).

### 7.1 *Biological innovations*

Open source can have a place even in fields dominated by proprietary strategies, such as the life sciences. Open source tools are important—and growing ever more important—to life sciences research and development. Many of the most valuable and widely used enabling technologies in the field are bioinformatics software programs, licensed on terms that are open source in the strictest sense. A good starting point for readers interested in exploring the possibilities of open source software for biomedical and agricultural applications is the Web site of the Open Bioinformatics Foundation.[26]

What about open source licensing for non-software biotechnologies? Starting as early as 1999, a variety of life-sciences initiatives have consciously adopted one or more open source principles in attempts to overcome some of the challenges posed by an increasingly complex IP landscape. These initiatives include a Canadian proposal for a General Public License for plant germplasm,[27] a draft license (never adopted) for human genome project sequence data,[28] the data access policy of the international haplotype mapping (HapMap) project,[29] the Biobricks Foundation,[30] Tropical Diseases Initiative (TDI),[31] Science Commons,[32] and Biological Innovation for Open Society (BIOS).[33]

Many open source software licenses are drafted as generically as possible so that as many people as possible can use them, as templates, for as little cost as possible. It would be helpful, of course, if the life sciences had open source precedents or template licenses—or, for that matter, a voluntary licensing standard, equivalent to the OSD, or a set of best-practice guidelines. Such tools would not only help prospective licensees decide whether a biomedical or agricultural technology license is genuinely "open source"(thereby helping them judge whether it is likely to achieve the positive collaborative outcomes for which open source licensing is valued) but would also help prospective licensors set universally beneficial terms for technology transfer.

These tools, however, do not yet exist. In developing such tools, the biomedical and agricultural research and development communities could learn a lot from the experiences of software developers. However, it may turn out that biotechnology—which is a far more technologically diverse field than computer programming, and which relies on expensive, time-consuming, and complicated patents rather than automatic no-cost copyrights—simply does not lend itself to the use of template licenses.

Therefore, for the present, at least, IP managers should be wary of uncritically imitating existing attempts to formulate open source licenses for non-software technologies, both because these licenses are not generic enough to be appropriate in all contexts and because some may not truly embody the principles that make open source work. Instead, prospective licensors and their advisors should develop tailored strategies.

### 7.2 *Examples of open source in molecular diagnostics*

The following examples reveal how open source licensing could be advantageous in both the public and the private sector even outside the software context.

### 7.2.1 *Case #1: A nonprofit setting*

Suppose that a clinical scientist working in a not-for-profit setting (a university or hospital laboratory) discovers a genetic mutation that seems to correspond with the occurrence of an inherited disease in one of his or her patients' families. Using standard molecular biology tools, the scientist creates a diagnostic test and confirms the discovery. Imagine that the diagnostic test is patentable, but, because there are probably tens or hundreds of mutations associated with the disease, the new test will detect only a fraction of these mutations. As a result, the test has limited value.

Clearly, the utility of this diagnostic test—and hence the utility of the service the scientist's lab provides to patients, their families, and the community as a whole—would be enhanced if the new test could be combined with previously existing tests for other mutations associated with the same disease. The utility of the new test would also be enhanced by increased use: the more people who use the test, the more likely that systemic errors would be detected and corrected, and the greater would be the cost-effectiveness, for regulators, of enforcing best-practice standards for the test.

In this case, a copyleft-style open source license might be the most sensible way to protect the new genetic test. Such an approach would ensure that users do not have to pay license fees to subsequent developers in order to gain access to the most comprehensive version of the test.

### 7.2.2 *Case #2: A for-profit setting*

Suppose now that our hypothetical scientist works for a small company that operates on a mixed-revenue business model. Some of the company's revenue comes from the development and marketing of diagnostic tests for use in hospitals, physicians' offices, and in the home. More revenue comes from data analysis and contract research services. The rest of the revenue comes from licensing its collection of gene patents.

The inventor's company also conducts broad-ranging R&D activities that are economically important to the company in two ways. First, by developing and patenting new technologies, the company generates more revenue through patent licensing. Second, the company's research agenda enhances the company's reputation as a high-tech organization, which in turn attracts new customers. Because of its small size, the company's stand-alone research capacity is limited, so it makes a point of pooling resources with other research organizations. However, competition is fierce among small companies that want to forge alliances with the most desirable partners from industry and the nonprofit sector, so our imaginary company is always looking for ways to enhance its capacity for cutting-edge research and to advertise its excellent track record of scientific collaborations.

If the genetic test mentioned above were to be licensed under a copyleft-style license, the company would gain access to any new versions of the test—which are likely to be more reliable, easier to perform, and more comprehensive than the old ones—without having to pay exorbitant fees to other developers or having to deal with restrictive licensing terms. The better the test becomes and the cheaper it is for people to use, the larger the market will be for associated products and services (for example, test kits and genetic counseling). If the company is known as the producer of a cheap, effective test, the company's reputation will improve; the enhanced reputation, in turn, will lead to greater demand for its contract research services and, perhaps also, greater demand for access to the company's gene patents. Further, a better standing in the industry will make it easier for the company to attract and keep excellent employees and research partners. Meanwhile, the experience of leading an open source project would give the company a chance to acquire, and demonstrate, experience in collaborative research.

Note that although open source development makes sense for the two hypothetical cases outlined here, open source may not always be appropriate. There are no hard-and-fast rules about whether or not the benefits of an open source approach will outweigh the costs, so each situation must be evaluated on a case-by-case basis.

## 8. CONCLUSIONS

Much work remains to be done before open source licensing is fully integrated into the biomedical and agricultural spheres, and this chapter has done no more than scratch the surface of the topic. Ideally, those who are interested in exploring nonproprietary exploitation strategies in the life sciences will continue discussions that will eventually lead to the creation of open source standards and open source license templates. Until then, prospective licensors in the life sciences must be prepared to independently interpret the lessons of open source software licensing. ■

**ACKNOWLEDGEMENTS**

I would like to acknowledge the contributions of the *Handbook's* editors to both the style and content of this article. A more comprehensive discussion of this topic is also available at http://rsss.anu.edu.au/~janeth.

**JANET HOPE**, *Project Director, Co-operative Intellectual Property Management, Centre for Governance of Knowledge and Development, Research School of Social Sciences, Australian National University, Canberra ACT 0200, Australia. janet.hope@anu.edu.au*

1 Thanks to considerable scholarly attention in recent years, a broad consensus regarding the essential features of open source development is gradually emerging. A good starting point for interested readers is Demil B and X Lecocq. 2006. Neither Market nor Hierarchy nor Network: The Emergence of Bazaar Governance. *Organization Studies* 27:1447-1466.

2 See E.S. Raymond. 1998. The Cathedral and the Bazaar. *First Monday* 3(3); Benkler Y. 2002. Coase's Penguin, or, Linux and the Nature of the Firm. *Yale Law Journal* 112:369.

3 Feldman RC. 2004. The Open Source Biotechnology Movement: Is it Patent Misuse? *Minnesota Journal of Law, Science & Technology* 6(1):117-168; Boettinger, S. and Burk, D. 2004. Open Source Patenting. *Journal of International Biotechnology Law* 1:221.

4 The full text of the OSD is available online at www.opensource.org.

5 Rosen L. 2004. *Open Source Licensing: Software Freedom and Intellectual Property Law*. Prentice Hall: New Jersey. pp.8-11.

6 Rosen L., et al. 2003. Live from Silicon Valley, Views of Open Source Practitioners, p.39. In *Legal Issues Relating to Free and Open Source Software* (eds. B. Fitzgerald & G. Bassett), Volume 1 of *Essays in Technology Policy and Law*. Queensland University of Technology School of Law: Brisbane.

7 www.fsf.org/.

8 www.debian.org. For a history of free and open source software, see also Levy S. 2001. *Hackers: Heroes of the Computer Revolution*. Penguin: New York; Weber. 2004. *The Success of Open Source*. Harvard University Press: Cambridge, MA.

9 The free software definition is online at www.gnu.org/philosophy/free-sw.html.

10 For more information on "Debian-free licenses," see www.debian.org/legal.

11 For a discussion of this process in the context of the development of hybridoma technology, see Cambrosio A and P Keating. 1998. Monoclonal Antibodies: From Local to Extended Networks. In *Private Science: Biotechnology and the Rise of the Molecular Sciences* (ed. A Thackray). The Chemical Sciences in Society Series. University of Pennsylvania Press: Philadelphia. pp. 165–181

12 For a discussion on these, see, for example, Nottenburg C. 2004. Analysis of "Junk DNA" Patents. *Cougar Patent Law: Seattle and CAMBIA*. Canberra. lorac.typepad.com/patent_blog/files/simons_patents_analysisf.pdf.

13 According to Sir John Sulston, the possibility of alienating key collaborators was the main reason a copyleft-style license was not adopted for human genome project sequence data.

14 See Creative Commons' Web site, creativecommons.org.

15 In Larry Rosen's words: "[W]hatever they charge for, you only have to pay once." Larry Rosen, *Personal Communication*. March 2003.

16 *Codified* refers to the nature of the information incorporated into a technological artifact. Highly codified knowledge is organized and easily reproduced and transferred. Uncodified information, on the other hand, consists of undeveloped ideas and/or unarticulated know-how. Any biotechnology that includes living material is likely to be highly uncodified because living systems are so complex. Similarly, a laboratory technique that can only be reliably performed after hands-on training from an experienced practitioner is also uncodified.

17 For an empirically verified list of motivations to contribute to open source development, see Kim EE. 2003. *An Introduction to Open Source Communities*. Blue Oxen Associates. www.blueoxen.org/research/00007/BOA-00007.pdf.

18 Drews J. 1999. *In Quest of Tomorrow's Medicines: An Eminent Scientist Talks about the Pharmaceutical Industry, Biotechnology and the Future of Drug Research*. Springer-Verlag: New York. pp. 229–232.

19 See *supra* note 17.

20 Powell WW. 2001. Networks of Learning in Biotechnology: Opportunities and Constraints Associated with Relational Contracting in a Knowledge-Intensive Field. In *Expanding the Boundaries of Intellectual Property: Innovation Policy for the Knowledge Society* (eds. RC Dreyfuss, D Zimmerman and H First). Oxford University Press: Oxford, U. K. pp. 251–266.

21 Perens B. 2005. The Emerging Economic Paradigm of Open Source. *First Monday. Special Issue #2: Open Source — 3 October 2005*. Online at firstmonday.org/issues/special10_10/perens/index.html.

22 Heller MA and S Eisenberg. 1998. Can Patents Deter Innovation? The Anticommons in Biomedical Research. *Science* 280: 698–701.

23 A copyleft license is formally similar to a *grant-back*, a type of license provision that in the patent context has sometimes been regarded with suspicion by competition authorities. See Boettiger S and D Burke. 2004. Open Source Patenting. *Journal of International Biotechnology Law* 1: 221. However, it is functionally distinct because it requires improvements to be made available on the same terms to all, thereby creating a level playing field between the initial licensor and follow-on innovators.

24 Bedell K. 2004. Open Letter to Sun from Eric Raymond. *O'Reilly ONLamp.com*, www.oreillynet.com/onlamp/blog/2004/11/open_letter_to_sun_from_eric_r.html.

25 See *supra*, note 5. p.104.

26 www.open-bio.org.

27 This proposal was developed by Tom Michaels, then of the Ontario Agricultural College, University of Guelph. A copy of the proposal is available from the author on request.

28 The proposal to publish genome sequence data under a copyleft-style license is described by the then-director of the Sanger Centre in Sulston J and G Ferry. 2002. *The Common Thread*. Random House: London. pp. 211–213.

29 For a post-case analysis of the HapMap data access policy, see Gitter D. 2007. Resolving the Open Source Paradox in Biotechnology: A Proposal for a Revised Open Source Policy for Publicly Funded Genomic Databases. *Houston Law Review* 43 (forthcoming).

30 Baker D. 2006. Building a Fab for Biology. *Scientific American* 294: 44–51; Endy D. 2005. Foundations for Engineering Biology. *Nature* 438: 449-453.

31 See Maurer S, et al. 2004. Finding Cures for Tropical Disease: Is Open Source the Answer? *Public Library of Science: Medicine* 1(3):e56. See also, the TDI Web site at www.tropicaldisease.org.

32 sciencecommons.org/.

33 Dennis C. 2004. Biologists Launch Open Source Movement. *Nature* 431:494.