2 COOPERATION AND PROPERTY RIGHTS IN THE COMMONS

The networked medium of the Internet lowers the technical barriers for distributed collaboration and peer production, however the challenges of creating and sustaining large social and cooperative enterprise are immense. This chapter is a survey of prior literature and current theories of cooperation and property rights, particularly in the context of distributed online communities.

The recent “Free Software” and “Open Source” movements have been influential in the software community; for many people, this notion of distributed production in the public domain appears appealing in different contexts of human enterprise. What are the social incentives, norms and mechanisms that emerge in such distributed communities to support peer production? Under what conditions is an open source approach effective and what are its serious limitations? Few studies manage to address such questions in a critical manner. While open source is appealing for ‘socially closed-knit’ and technically savvy communities, it presents many challenges for sustaining the social organization and productive capacity in diverse distributed networks.

Applying models of distributed peer-production towards knowledge-intensive design, which is traditionally situated in physical and cultural settings, requires careful consideration. What can we learn from cooperation, user innovation and social norms in co-located communities to understand innovation in distributed online settings? Transferring the open source model to physical knowledge-intensive domains like craft and product design, requires us to critically examine the nature of the design process, role of physical interaction, culture and “place” as well as the social norms and notions of intellectual property rights in such “communities of practice”.

Distinct notions of property rights regimes emerge within different social settings, and conversely influence the level of conservation, access, exclusivity and incentives for productive capacity. We examine both private and communal property rights, and the relationship to the public domain. We consider property rights in the context of natural resource systems, small-scale product innovation as well as online digital content. Finally, we explore the key challenges and mechanisms that support intellectual property rights for grassroots innovators and subpatentable innovations. Many tensions emerge between perceived notions of protection, compensation, and public good. Appropriate policies must be carefully devised within specific contexts in a participatory manner, and facilitated by their own communal and institutional settings.

Greater clarity is needed to resolve diverse notions of what I generally refer to as “cooperation in the commons”.

Open Source, Free Software, Public Domain and the Commons

There is some degree of ambiguity in the definition and usage of the terms Open Source, Free Software, Public Domain and the Commons, which are often used synonymously with each other.

Open Source usually refers to software (or source code) made available in the public domain under certain social/legal contracts, ensuring varying agreements for ownership, access and modification. Open Source software projects are usually undertaken, managed and maintained as cooperative efforts by individuals or groups in distributed geographic and institutional settings, though this is not always the case. Free Software primarily refers to software projects developed under the GNU GPL licensing scheme. The term Free Software was coined by Richard Stallman in the mid-1980’s prior to Open Source however it has had limited usage and adoption in the mainstream, while Open Source has emerged in the late 1990’s as a common term in the software community. Much of this has to do with the misperception of “free” as being unprotected dissemination, while it was meant to invoke democratic ideals of “freedom” for production of software code. Open Source, later coined by a group of software hackers including Eric Raymond, was a response to this perception trying instead to combine ideals of Free Software with principles of product-oriented economic payoffs for the mainstream software industry.
In dictionary definitions *public domain* is defined as either government owned land or unprotected property that is free for anyone to use. The term *commons* has been used in the British Parliament to represent non-titled citizens, agricultural fields in Europe prior to their enclosure and for public spaces in the US [Hess2001]. These terms embody notions of ownership (or lack thereof), access, exchange and governance with respect to communal and public good to varying degrees. The interpretations of different scholars provides greater clarity:

“The concept of the public domain is another import from the realm of real property. In the intellectual property context, the term describes as a true commons comprising elements of intellectual property that are ineligible for private ownership. The contents of the public domain may be mined by any member of the public.” [Littman1990]

“The commons: There’s a part of our world, here and now, that we all get to enjoy without the permission of any.” [Lessig1999]

“In relation to the intellectual public domain, the commons appears to be an idea about democratic processes, freedom of speech, and the free exchange of information.” [Hess2001]

Overall despite the similar usage of the terms, operationally to some extent one can distinguish reference to the *public domain* as to invoke ownership concerns, while that of the *commons* as to invoke notions of access, governance and exchange. Hence, in this writing we will refer to both terms under such distinct contexts where possible i.e. we will consider notions of intellectual property rights in the public domain, while social interactions and behavior in the commons. We will refer to *Open Source* and *Free Software* primarily in the context of software projects.

In this section we examine the conditions that support cooperative production in the commons and subsequently the role of intellectual property rights regimes emerging in this process. These two related social phenomenon are examined in the context of both distributed participants developing software as well as co-located communities engaged in product design innovation. Studies of the Open Source software movement as well as patterns of user innovation in design of sporting goods and handicrafts will provide some insights into behaviors, incentives and conditions for peer production in the public domain. We will consider studies showing how open source projects are actually conducted, and the conditions under which they succeed or fail. In the second half of this section, we consider the role of property rights in cooperative innovation; we look at the attributes of private and common property rights, and lessons from studies of property rights in natural resource systems. We then examine the politics of intellectual property rights in the context of technology innovation and access in developing countries. Finally, we consider key lessons for IPR in digital networks and distributed communities.

### 2.1 Distributed Cooperation: Lessons from Open Source and User Innovation

What does the literature reveal about open source initiatives? Why do people contribute freely to open source software (OSS) projects? What are the key issues for understanding online “cooperation” among different parties? This section examines a number of recent studies and writing on the open source phenomenon in software development, product design (sporting goods and handicrafts) as well as the notion of “peer-production” of information goods by distributed online communities. The key factors to consider are the incentives and challenges for distributed cooperation, and how they related to the context of knowledge-intensive design.

#### 2.1.1 Social Incentives and Economics of Open Source Software

Though there has been a great deal of interest in the process of open source software development, the underlying social and economic mechanisms as well as its effectiveness as a productive mode of organization has been much debated.

In a recent study, economists Lerner and Tirole [2000] examine a number of social factors that are considered to contribute towards open source projects:
1. Altruism, though possible, does not provide a consistent or satisfactory explanation. Authors point out that altruism should not be particularly applicable in the software industry only.

2. Delayed Rewards or “Signaling Incentives” for individuals – namely:
   a. Open source contributions are more visible to outsiders than in closed-source.
   b. Personal initiative and responsibility in open source projects.
   c. Fluid Labor market in open source environment i.e. programmers can easily shift their efforts elsewhere, including source code when needed.

3. Reputation: Involvement in open source projects can serve as a point of entry to signal ones talent to peers, and potential employers.

4. Visibility, personal interest or critical nature of a project can lead to increased participation; however a relative loss in popularity may cause early abandonment.

5. Low possibility for large commercial payoff may allow people to contribute freely; however they may be tempted to move to proprietary mode or cease contributing if this condition changes.

Another recent survey of participants in open source projects\(^{16}\) was conducted by Karim Lakhani with the Boston Consulting Group and Sloan School at MIT. The survey revealed several key motivations including 1) participating in an intellectually stimulating project, 2) improving their skills, 3) having an opportunity to work with open source code, 4) developing programs to solve both work related and personal needs. Hence the motivations suggest the key role for learning and problem solving in such initiatives, rather than commercial gains.

Lerner and Tirole suggest several mechanisms that encourage open source software efforts:

1. Lowering barriers for accessing and contributing to development projects – emerging with the spread of Internet and collaboration or code management tools like CVS.
2. IP and licensing agreements such as GPL, Free-GPL, Debian and other licenses.
3. Giving credit to contributors is essential to the open source movement. Reputational benefits provide real effects on developers, in some cases leading to tangible rewards.
4. Credible leadership to provide a vision, manage tasks, attract contributors and “keep a project together”.

Many motivations for involvement in open source projects often cited include learning from experts, reputation and career benefits, personal interest in solving a problem etc. Rather than focusing on personal factors influencing individuals, it is perhaps more instructive to examine the institutional norms and social contracts established in the open source community that encourage this mode of production. Kelty [2001] cites an analogy with the sciences referring to work of the sociologist Merton, who focused on the institutional norms of science rather than the character of individual scientists. Merton [1973] asserted that recognition and reputation (play crucial roles in the incentive structure of science. Citation indices in science serve as a indicator of value and reputation, and a means of registering intellectual contributions. Latour and Woolgar [1979] refer to the non-monetary exchange in science by exploring the “cycle of credit” where reputation leads to funding grants and vice versa over time. Hence, reputation and credit metaphorically serve as currencies of economic motivation in science. One can argue that to a great extent similar institutional norms and mechanisms are at play in the open source software community.

### 2.1.2 The Limitations of Open Source: Conditions and Misconceptions

While there has been a great deal of interest in adopting the Open Source model, one needs to closely examine under what conditions it is truly an effective form of production. What is the social nature of open source projects? To what extent is it based on democratic community of distributed participants with diverse interest and expertise? Is it limited to software-based projects with highly technical developers and users? To better understand the role of community-based models in software development, Krishnamurthy [2002] conducted a study of 100 mature open source software projects on Sourceforge.net (an online software repository). His empirical

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\(^{16}\) [http://www.osdn.com/bcg/bcg-0.73/BCGHackerSurveyv0-73.html](http://www.osdn.com/bcg/bcg-0.73/BCGHackerSurveyv0-73.html)
findings rebuke commonly held notions that most open source initiatives are based on intense contributions from large distributed communities. Some key findings suggest:

1. Most mature open source programs are developed by a small number of contributors. The median number of developers was 4 and the mode was 1. Only 29% of all projects had more than 5 developers while 22% had only one developer.

2. Most open source projects do not generate much discussion over email or online forums. Of the 100 projects 33 had no messages during the lifetime of the product development.

3. The number of developers working with a project was correlated with its age – older projects attracted more developers.

4. A smaller percentage of participants were assigned as project administrators in large groups. The median number of project administrators was 1.

5. In an informal examination of software projects listed on Sourceforge.net, Chandavarkar [2002] finds that nearly 60% are intended for developers and system administrators; among the 100 most active projects that list end users as the intended audience, 73 of them also list developers and sys-admins. Hence there is a greater focus on back-office functionality and the intended community is largely directed towards a “techie” audience.

These findings suggest a model of open source development, more akin to a lone developer (or cave) model of production rather than a large democratic and distributed community. Larger open source projects require greater publicity and the role of credible vision and leadership towards compelling challenges (as in the case of Linus Trovalds in Linux). Krishnamurthy suggests that it is important to “delineate the relative roles of individuals, communities and social networks" in the process of open source development, rather than focus solely on the active contributors to the product development. Non-developers often contribute feature suggestions, documentation, try out the software and provide bug reports etc. Chandavarkar speculates that the open source methodology "does well within technically savvy communities focused on their own needs, whose members are already patched into networks," while he expresses doubt over its ability to define requirements in a “non-techie” context. The organization of average open source projects resembles a limited access “cave” of elite developers, surrounded by technically savvy lead users without much control over the project, and other peripheral users with less involvement. Hence, one needs to rethink the traditional notions of democratic community collaboration and modes of production in such open source initiatives.

In a critical look at the Open Source movement, Nikolai Bezroukov [1999] believes that the Eric Raymond’s bazaar model17 [2001] provides an overoptimistic and simplistic view of the open source software (OSS) development process. Popular press often emphasizes successful projects, however the difficulties with aborted attempts are rarely highlighted. This creates an impression that “open source is a panacea and a magic bullet that will solve almost all difficulties.” Though Bezroukov feels the overall approach has many useful attributes, particularly for learning, he outlines a number of problems and misconceptions inherent in the model (as it is generally perceived). I summarize some of the key issues here:

1. *Brooks Law:* Though it is often argued that a large number of distributed developers can be engaged in open source software development using the Internet, this does not eliminate the problems of coordination and integration that most complex systems require. Fred Brooks argued that the complexity and communication costs of a project rise with the square of the number of developers, commonly cited as Brooks Law. Though networks help mediate some of this overhead, the challenges of social organization must be addressed to enable large distributed software projects.

2. *Distributed Debugging:* It is often claimed that many talented developers can debug the same code in parallel without any coordination other than email; however there are many challenges particularly for large complex systems with a great deal of successive layers of non documentos code. Unfamiliar developers who enter a project late in the process

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have a momentous if not impossible task to resolve such difficulties. Bezroukov feels one should recognize the critical role of project management and documentation. There is also the question of the appropriateness of forcing gifted developers to solve such tasks, unless there are compelling incentives and rewards to have critical bugs resolved. Here some notion of ownership, control and stake in a project must be established.

3. **Cathedral vs. Bazaar:** The level of decentralization and democratic organization in open source software projects is open to review. In most large complex projects developed under time pressures, there is a need for centralized authority and management. In the Linux OS, there seems to be a mechanism in place whereby new code patches are submitted to core developers who filter and review them before sending them to Linus Torvalds who makes the final decisions whether such patches are worthy of incorporation in the OS. Hence there seems to be a centralized and hierarchical process to manage the integration of numerous distributed contributions, more akin to the cathedral.

4. **Quality of OS Software:** Bezroukov argues that simply because a project is open source, does not mean it would automatically yield the best outcomes. Despite the successes of Linux and the Apache server, there is no general implication that all OSS developed has better features and lower bug reports. There are many different variants of Linux with varying grades of stability and security, although the Apache server is often cited as having higher performance among web servers. However, there is no conclusive study that effectively compares the performance of different types of OSS systems with commercial or individually developed software, to resolve this question.

5. **Sustaining Individual & Cooperative Efforts:** For large voluntary initiatives sustaining the development of a complex system in a productive manner is immensely challenging. There is a tremendous responsibility for dedicated leadership who needs to manage the process, keep up with ongoing efforts and often assert authority. Without greater distribution of the workload there is a risk of “burnout” on the part of leaders and key developers, particularly when a complex production level system must be developed under short time constraints and without “critical mass” of supportive developers, users or resources to assist in their efforts. In addition, Bezroukov also points out that just as in any social setting, there are bound to be conflicts of interest, ego and status which must be gradually dealt with in the social norms and organization as such initiatives scale up. He takes a less than optimistic view saying “the rosy view of open source as an ideal community of constantly cooperating individuals is an illusion.”

To better understand the nature of open source software development, Bezroukov finds it useful to consider it as a special case of academic research. This comparison with the scientific community suggests that open source may inherit many similar incentives, structures, and mechanisms. His analogies include the role of reputation vs. monetary gain in such communities, genuine interest and personal stake in the domain, and the nature of distributed cooperation and peer-review in the academic community. He likens the distributed software teams to that of informal communities of scientists that historically used hand-written letters to share ideas and criticism. One example of conflict that Bezroukov cites “Like scientific communities, the free software movement is constantly driven by factional disputes over ideological and technological issues.” He goes on to state “the problems of open source are by and large the same as those that confront academic culture and are better understood in this context.”

A key insight he mentions is the potential influence of institutional setting, reputation and access that provides legitimacy and resource to ensure the success of cooperative initiatives. He notes the work of Nobel laureate Pyotr Leonidovitch Kapitsa investigating the phenomenon of the “tragedy of provincial talent” among Russian physicists - “Kapitsa understood that the proximity to leading centers of research and to members working at these centers greatly contributes to the acceptance of a discovery.” Hence, Bezroukov feels “as in an academic community, direct contacts with influential community members and access to major centers of development are
very important and can significantly reduce the barriers to the acceptance of an idea,” Hence, several limited parallels can be drawn with the academic community that may be instructive in examining Open Source communities, however one must be cautious to recognize the unique social and institutional settings within which each operates. Overall, there are significant challenges for large-scale OSS development, and commonly held notions on why such initiatives succeed must be critically examined.

2.1.3 Challenges of Distributed Peer Production

Beyond the Open Source movement in software, one finds increasing evidence of distributed activities conducted online; as we will see here, most of these can be categorized as “lightweight forms of information production”. In a widely cited paper, Yochai Benkler [2001] examines this phenomenon of “peer production” in contrast with market-based production activities. He states that the current information economy is largely based on property rights, contractual exchange, and hierarchically managed firms, while trends in the Open Source projects would seem to dispel such mechanisms. Though this observation would seem compelling at the surface, we have seen that even in Open Source communities, diverse notions of property rights, social organization as well as centralized and hierarchical management structures do emerge. Hence these assumptions can be problematic if they are not examined carefully, however they remain a central claim in Benkler’s arguments towards novel forms of distributed peer production.

Applying Peer Production to Knowledge-Intensive Domains?

Benkler believes that the specialized attributes of distributed software production are not unique and can be found in other modes of information production and communication (even in mundane tasks like proofreading). His basic claim is that “different modes of production are better or worse at processing different types of information”. He considers many different forms of peer production: 1) Content – e.g. identifying craters on Mars on a NASA website18, 2) Relevance/accreditation – e.g. book reviews on Amazon.com or volunteer editors verifying links submitted to the Open Directory Project19, and 3) Value-added distribution – e.g. Distributed Proofreading20 of public domain “etexts” by volunteers for Project Gutenberg21. In all of these cases the tasks are information-based, well defined and easily discretizable. His main argument for distributed peer-production is that it allows people to “self-identify” for tasks they have competencies in; this he feels makes is better suited for activities in which human expertise is the main input, as long as coordination problems can be resolved. However much of the analysis is based on models of Open Source software and online interactions around information processing, review and production. I believe this model is problematic in product design and knowledge-intensive domains, without addressing a number of key problems arising.

The Problem of Incentives

Benkler considers the problem of incentives a trivial one if sufficient contributors can be involved. He feels that people are willing devote their free time to “creative play”, based on behavior observed in the online contribution websites he mentions and the free software movement. I would say that this notion of “creative play” does not scale well beyond small transactions where a substantial product must be developed; here ones needs social mechanisms and incentives to transform creative play into responsibility for creative production. In the Free Software movement, incentives often cited are reputation gains and opportunity for subsequent consulting jobs. These are based on longer-term projects with implicit (or explicit) norms social contracts among the community created. However, Benkler states “As a practical matter, given the diversity of motivations and personal valuations on the productive activity itself and on the likelihood of desirable consequences from participation, the incentives problem is trivial.” He believes that a collaboration problem solved on a large scale with thousands of individuals, easily resolves the incentives problem. Leaving aside the problem of orchestrating such a large collaboration, this

18 http://clickworkers.arc.nasa.gov/top
19 http://dmoz.org/
20 http://promo.net/pg/
21 http://charlz.dynip.com/gutenberg
still seems a rather naïve assumption as it views the distributed production as a kind of mass manufacturing with homogenous inputs without any notion of social norms, conflicting goals and ongoing interaction among the community of producers.

**The Problem of Discretization**

Benkler claims that the “modularity of the information product and granularity of its components” determine its capacity to be produced on a peer-production model. This kind of peer-production model would then be limited to domains where there are distinct and identifiable tasks that can be easily partitioned among distributed individuals. It would only seem to apply to simple transactions and service-based contributions which (like posting a document to be proofread etc). While in more involved design and knowledge-based activities such discretization and boundaries in production tasks are not clearly demarcated. Doing so effectively in itself is an intellectual exercise, which could presumably be peer-supported. However, as we will see in design-related activities the “design” often emerges from the social interactions among designers, stakeholders and experts. Hence partitioning all the potential design tasks beforehand is problematic.

**The Problem of Coordination and Integration**

Benkler states that the key problem for peer-production is that of coordination, integration and quality control over all the peer contributions; this he feels can be accomplished by either 1) iterative peer production of the integration function itself, 2) technical solutions embedded in the collaboration platform, 3) a norm-based social organization or 4) “limited reintroduction of market-based and hierarchical mechanisms”. Though technical solutions can assist, there is a clear need for social organization of the coordination, management and integration functions, which means that a distributed community must be formed with clear (and perhaps evolving) roles, norms and abilities to enforce action. Benkler feels that if we can simply reduce the transaction costs involved in peer participation of projects, the problem of coordination is less critical – this I believe is a simplifying assumption overlooking the role of social organization and norms that emerge even in online communities. Transaction costs for an individual spamming a mailing list with inappropriate content are near zero, however this behavior is generally prevented by the social norms established in the online community.

**The Problem(s) of Appropriation**

Benkler believes that in this new mode of “commons-based peer-production” the absence of any property rights is a central organizing feature. He recognizes the role of common property regimes used by communities to monitor and regulate physical resources, using both formal laws and social norms. Based on prior work by Ostrom [1990], Benkler cites two issues that may be of concern: provisioning – process of specifying who receives goods vs. allocation – process of distribution of those goods. He considers them separate problems as he feels that if a resource were easily renewable and properly allocated then there would be no need for institutions to ensure provisioning. So Benkler considers peer-production of information a “purely provisioning problem”. He points to a number of factors involved in provisioning and appropriation:

1. Once information is produced, there is no problem allocating it as it is nonrival (usage by one user does not impede others). According to this logic as the size of the pool of information production increases, free-riding (or appropriation) can be tolerated as long as there are sufficient contributors. In that case a high degree of appropriation by others (end users) would provide greater reputational gains to the producers.
2. Studies of Free Software show that “unilateral appropriation” in the form of commercialization for private profit would cause a negative effect on producers, who may subsequently choose to disengage or privatize their own efforts (through nondisclosure, property rights or seeking their own commercialization). Benkler makes an important point that individuals would be more likely to contribute their efforts (and implicit appropriation) by nonprofit entities like NASA rather than firms like Microsoft.
3. An important motivation for contributors is to have “indirect appropriation based on continued access to the joint project”. For some contributors nondiscriminatory access in
the public domain may be a preferred means to reduce misappropriation. Adopting social contracts such as GNU GPL licenses mitigate the risks of appropriation to some extent.

4. Benkler mentions the need for (low-cost) “provisioning the integration function” i.e. assuring the quality of the contributions by peer review, automated methods, hierarchical organization or market-based initiatives.

5. Benkler finally proposes a notion of “cooperative appropriation” i.e. when a group of contributors or users develop a means to service or customize information goods produced, based on their reputation (indicated by level of contribution) in the peer community. This then transforms the process to one akin to common property regime.

Hence, there are a number of significant challenges for peer-production, the most critical of which seems to be the problems related to incentives and appropriation. We will review the literature in property rights in the next section to shed more light on problems of appropriation. Despite the limitations and problems of applying the model of peer-production, Benkler approach has implications primarily for information production. He believes that peer-production has “systematic advantages over markets and firms in matching the best available human capital with the best available information inputs.” However in most design and knowledge-intensive domains, a simple partitioning of the tasks and creating coordination mechanisms by themselves is not entirely feasible, and the nature of incentives and property rights turns out to be somewhat more complex. Cooperative design and knowledge-intensive peer-production requires establishing what Chandavarkar referred to as a “community of practice” [2002], with common goals, incentives and norms for cooperation as well as social contracts and even notions of property rights and management. We examine these arguments later in the case of user innovation in sporting goods and handicraft producers, as well as in the work on communal norms and practices by Ostrom and others in the next section.

2.1.4 Patterns of User Innovation in Sporting Goods and Handicrafts

A recent study by Sonali Shah [2000] at the Sloan Business School at MIT examined patterns of innovation in sporting equipment, i.e. Skateboarding, Snowboarding, and Windsurfing, three relatively young sports with considerable evidence of user innovation. The study unveiled that in each sport the innovations were typically developed by early participants or lead users rather than equipment manufacturers, not even ones from allied fields. Young and technically unsophisticated users evolved their innovations by experimentation, field trials, and playing the sport, discovering problems and making revisions quickly. Some innovators supported their primary activity of playing the sport by making and selling their innovations, while others later founded small companies some of which become major producers of the equipment.

A few key findings are worth examining further:

- In these fields, innovating users had very limited ability to gain benefits from their innovations by commercial activities such as patenting and licensing their intellectual property to others.
- Manufacturers who patented innovations generally did not license it to others, preferring to benefit from producing and selling them. Individuals sometimes patented but innovators did not find patenting and licensing a successful means for gaining benefits. Only one case of patent & licensing was observed, 2 other cases showed patents overturned (in court) or licensing payments stopped as manufacturer’s management changed (despite legal intervention).
- Low level of patenting was observed (17%) for a number of reasons: the technical novelty of the innovation was not considered patentable, innovators were not interested in patenting or immediate public disclosure made patenting impossible outside the US.
- Lead users had ready access to “sticky information” (situation and site specific information necessary for developing the innovation) having invested sufficient time playing the sport, which was not easily transferable to manufacturers.
- Lead users (and not manufacturers) are found to have greater incentives to innovate in small and uncertain markets.
The costs of developing prototypes was low, developed using easily available materials and simple methods, while providing immediate benefits to the users i.e. being able to play their sports better.

Of the expert practitioners who innovated, 71% sought to profit from their innovations by forming small lifestyle firms to manufacture and sell them as products. Innovators adopted the role of small producer as the “switching costs” (startup or entry costs) were quite low, relying on relatively low-tech and accessible methods of manufacture (with word-of-mouth advertising), while still allowing users to practice their sport & lifestyles.

Eric von Hippel [2001] believes this pattern of user-led innovation is supported by access to “user toolkits for innovation”. Such toolkits give users the freedom to innovate by allowing preliminary design, simulation, customization, prototyping or evaluation in their unique settings. Hippel cites examples of such toolkits emerging in fields such as integrated circuits in the 1980’s, which allowed customers to carry out need-related design work for themselves. This lead to better adoption of the products and standards by both end users and competitors in the industry. Hippel proposes that such user toolkits would emerge in many different industries with customized products and heterogeneous customer needs. One can argue that access to such user toolkits in the software industry in the form of common protocols and APIs, development platforms, and libraries of software components (as well as the fluid medium of the Internet) technically allowed distributed communities to join and support Open Source software projects. The grassroots users involved in modified sporting equipment innovations relied upon informal user toolkits with easily available materials and processes.

Another analogy towards cooperative innovation in product design is that of traditional handicrafts. Chandavarkar [2002] examines the role of social processes, place and communities of practice in the development of the crafts. Though there are many analogies with the Open Source movement, there are also critical differences and challenges for open collaboration in this domain. Chandavarkar cites a number of ways in which traditional craft embodies principles of open source methodology, including 1) practice and development of the crafts is situated in a community, 2) often the ideas belong to the entire community – if any single person comes up with an innovation then “it serves to extend the visual language of the entire community”, 3) compensation is not expected for the ideas but for the expense of production and service provided, 4) Innovations are built on that of practices in the community in a gradual “bazaar” like manner, including peer review, 5) contributions to a craft are judged not only on utility but also how they extend the symbolic language for the community at large.

However, Chandavarkar points out two unique aspects of crafts that make the analogy with Open Source problematic: 1) outcomes of the craft community are embodied in tangible products of visual art and 2) the craft community is bound to a particular geographic context. These attributes suggest that the social, geographic and cultural context of the design and communities of practice plays an important role in shaping the sorts of products created, the nature of the cooperative activity and the norms for sharing and exchange among the community of practitioners. Chandavarkar believes the physical sense of place plays a critical role in design disciplines. While the open source methodologies rely on distributed “networks of practice” with people having functional or occupational links connected electronically, design disciplines rely on “communities of practice” with geographic, social and physical encounters that shape the memory and serendipity leading to collective design approaches and artifacts.

The work of Shah, Hippel and Chandavarkar suggests several critical aspects one must consider in projecting open source principles to user-led product design – 1) the “sticky” information or unique geographic and cultural attributes of the user community play an important role in the nature of innovations emerging (which makes it difficult to replicate by manufacturers and distributed communities), 2) user toolkits for experimentation and custom development gives users the freedom to innovate (these toolkits may emerge locally by the communities themselves), 3) The role of place and community setting is important in product design innovations, particularly where ideas emerge as a consequence of usage, social interactions and
shared cultural context among the community. Supporting user-led product innovations in communities of practice requires new toolkits, interaction technologies and mechanisms to interface the co-located communities with distributed participants. In addition, we need to consider communal norms for social organization and production as well as distinct notions of property rights. We will discuss communal property rights and norms in the next section.

2.1.5 Summary: Rethinking Open Source for Cooperative Design Innovation

While the Open Source approach is considered appealing and yet challenging even in the context of a technically savvy distributed software community, applying it towards knowledge-intensive design that is traditionally situated in physical and cultural settings, requires careful consideration. The networked medium of the Internet lowers the barriers for distributed collaboration and peer production, however the challenges of creating and sustaining large social and cooperative enterprise are immense. It is important to recognize the nature of social incentives including status and reputation, learning and skills enhancement, and the presence of credible leadership, determined actors (lead developers and users) and legitimate institutional settings. In contrast to the perception of most Open Source projects as large scale distributed and democratic initiatives, most efforts are comprised of small, highly technically savvy teams (or individuals) with a strong personal interest in the outcomes. The nature of social organization is usually more like a close-knit circle of key developers with some centralized or authoritative control, surrounded by lead users and others with less involvement. Like any communal organization, the community must gradually sort out conflict, control and appropriation of intellectual work. Transferring the OSS model to knowledge-intensive tasks like craft, hardware and product design, requires us to critically examine the nature of the design process, role of physical interaction, culture and “place” as well as the social norms and notions of property rights in such “communities of practice”.

2.2 Property Rights: Affordances and Conflicts for Innovation

Individual and cooperative production occurs within social and institutional settings, which determine the nature of norms, incentives, responsibilities and mechanisms for access and protection. Distinct notions of intellectual property regimes emerge within different settings, and conversely influence the level of conservation, access, exclusivity and incentives for productive capacity. Here we examine both private and communal property rights, and the relationship to the public domain. We consider property rights in the context of natural resource systems, small-scale product innovation as well as online digital content. Finally, we explore the key challenges and mechanisms to support intellectual property rights for grassroots innovators and subpatentable innovations. Many tensions emerge between perceived notions of protection, compensation, and public good. Appropriate policies must be carefully devised within specific contexts in a participatory manner, and facilitated by their communal and institutional settings.

2.2.1 Understanding Private and Common Property Rights

There are many important lessons that can be derived from how natural resource systems such as farms, fisheries and water resources are communally managed; these are clearly relevant to intellectual property regimes today. Elinor Ostrom [2000] contrasts the role of private and common property rights in the context of natural resource use patterns, pointing to the long ongoing debate about efficiency, equity and sustainability of different property regimes. The dominant view among legal and economic scholars has generally been that private property is superior to common property, however recent research challenges these presumptions.

Most economists consider private property rights to provide key incentives for owners to maintain resources and ensure productive utilization, while minimizing “free riding” by others. There is concern that communal property regimes do not invoke a direct relationship between individual contributions and long term benefits, such as from farmers who belong to agricultural cooperative vs. own and/or manage their own farms. Ostrom cites economists who presume 3 main sources of inefficiency: 1) rent dissipation i.e. not being able to capture value from communal use, 2) high transaction and enforcement costs to devise rules that allow mutual sharing without misuse, and 3) low productivity i.e. not having incentive to work hard to gain private returns. Hence private
property rights are assumed to have a direct impact on economic productivity of natural resources.

Ostrom points to scholars such as Henry Maine who conducted extensive research in Indian and Germanic village communities (in 1861), and concluded that joint-ownership preceded notions of private property. This work led to much debate and a flurry of publications that had much legal and political significance. However beliefs about the merits of private property led to legislation in Europe to eliminate collective landholding rights and allow individuals to take over communal properties. In newly independent developing countries many collective properties and resources were often either privatized or held by the government, however mechanisms for operating and conserving them were not usually put in place, leading to a great deal of mismanagement, waste and inequitable distribution in many cases.

Both private and common property rights regimes require emergence of “rules and rulers to establish, monitor and enforce a property system”. Both rulers and participants may specify or co-opt such rules in a manner to resist or benefit to the determent of others. Hence the so-called rent-seeking behavior is to be expected not only from participants but also the rulers. This indicates that neither private or common property systems are immune from outcomes of rent-seeking or mismanagement. Indeed one can easily find examples of both well-managed and poorly utilized resources among both private and common property regimes.

**Common Property vs. Open Access**

Ostrom clarifies the key difference among common property and open-access regimes; whereas in open access no one has the legal right to exclude anyone else form using a resource, in common property members of a clearly defined group can legally exclude nonmembers. There are few truly open access regimes for natural resources (like open seas and air) however some such as local grazing areas, inshore fisheries and forests are effectively treated as such; these are generally either 1) not contained within national boundaries, 2) no entity has laid legitimate claim to them or been able to enforce exclusion of non-owners, and 3) they may be consciously designated as such to guarantee access to the public. Some open access regimes lack effective rules defining property rights while others simply cannot enforce existing formal rights.

Ostrom makes an important point that the confusion between what is considered open access vs. common property has paradoxically led to a rise in local resources that are effectively treated as open access particularly in developing countries. The common property regimes that controlled streams, grazing or forests had evolved over a long time but were “rarely given formal status in the legal codes of newly independent countries”. The nationalization of such resources as government property led to less effective and efficient management. The institutional arrangements informally devised by local users to limit usage of such resources (hence conserving them for centuries) had been delegitimized while the state lacked resources, expertise or personnel to monitor such resources; this effectively led to a conversion of such resources under common property regimes to that of de facto open access (some of which led to disastrous consequences).

Therefore this distinction between open access and common property is critical among intellectual property regimes as well, suggesting the role for community norms and mechanisms to manage shared resources, provide incentives for sustained innovation, and limit access or disclosure as deemed appropriate.

**Taxonomy of Property Rights**

Ostrom defines a property right as an “enforceable authority to undertake particular actions in specific domains”. She outlines five main types of property rights: access, withdrawal, management, exclusion, and alienation each of which can be separately assigned to individuals or “collectivities”. Alienation refers to the right to sell or lease management or exclusion of rights i.e. serving as a means to negotiate all other rights. In economics, private property is defined in
terms of alienation i.e. obtaining legal contracts to negotiate rights, and regimes that do not support alienation are considered ill defined (as stakeholders cannot trade their interests or others purchase the system as a whole). Ostrom stress that it is important not to focus on one notion of property right but on five separate classes of rights that individuals or collectivities may hold. Any combination of these rights defines the operational nature of regime at different times for different participants (like owners, proprietors and claimants). For example, access and use of certain lands may be divided into so called “tenure niches” that vary by season, use, space or technology. One set of users may own rights to harvest fruits from trees while others own the rights to the timber, hence the tenure niches may overlap. Diverse schemes may be devised by participants to minimize interference or support rotation for utilization among shared resources.

In some cases having rights of a proprietor vs. owner in agricultural settings did not affect productivity however in densely settled regions, the absence of a title (i.e. ownership rights) reduced a farmer’s ability to sell the land or gain collateral for investment. Thus Ostrom points out a key finding from such studies is that “no type of property-right regime works equivalently in all types of settings”.

Communal Property Rights

Communal property rights are shared by groups of individuals when they have formed an organization (formal or informal) that exercises such rights of management or exclusion in relation to some resource units produced by the system. In her prior work “Governing the Commons” [1990], Ostrom shows that “all communal groups have established some means of governing themselves in relationship to a resource”, though not all are formally organized or legally supported. In a study of grazing lands managed by Swiss peasants, Netting [1981] finds that the same individuals used different property systems simultaneously i.e. both private (for family-owned parcels of land) and communal (for grazing lands on Alpine hillsides). Local communities themselves devised local rules for their own use. Interestingly, the nature of property rights system adopted depended on the attributes of the resource. Netting identifies five attributes conducive to development of communal property rights, which generally include low production value (per unit area) and returns for intensified investment by any individual while greater economies of scale for infrastructure and utilization of large areas.

Netting shows that recognition that cooperative rather than individual efforts yield greater returns in utilizing such resources as well as a need for sharing in economic or environmental risks, naturally leads to emergence of communal mechanisms for governance. In particular, Ostrom cites many studies that indicate, “When no physical or institutional mechanisms exist for sharing risk, communal property arrangements may enable individuals to adopt productive activities not available under individual property rights”. This is also supported by studies, which show that the variance of productivity of land is associated with the size of communally held parcels allocated to grazing.

Studies of communal property systems consistently indicate that they do not exist in isolation and are usually coexist with individual ownership e.g. joint and private irrigation systems managed by farmers. In addition, Ostrom shows that “formally recognized communal systems are usually nested into a series of governance units” that complement the skills of participants involved in managing smaller units from local villages to federations. Overall much evidence shows how communal systems instead of being inefficient, effectively deal with diverse local problems with low transaction costs. However the performance of these systems varies substantially like all property rights systems (including private enterprises). Ostrom characterizes several attributes of participants that influence the performance of their communal systems, generally related to having accurate and easily available information, common understanding of risks and benefits, generalized norms of reciprocity and trust, long-term stakes in the communal resources, and ability to develop low cost mechanisms for monitoring and regulation. Furthermore, Ostrom states that many of these attributes are affected by the larger regime within which the system is embedded – “If the larger regime recognizes the legitimacy of the communal systems, and is facilitative to its self organization… the probability of participants adapting more effective rules
over time is higher”. Hence the institutional setting and support plays an important role in the nature of effective communal property rights systems emerging and in their sustained operation.

Finally, Ostrom stresses the importance of participatory design and implementation of property rights systems, so that participants consider such rules legitimate, fair and effective; in the absence of shared ownership of the property rights regime itself, there is greater incentive to devise evasive strategies. A paradoxical notion is that the “very process of allocating quantitative and transferable rights to resource units may undo some of the common understandings and norms that allowed communal ownership system to operate” at low transaction costs. Hence, the way in which a property rights regime is introduced or facilitated within a community is a critical aspect of ensuring its acceptance, governance and effective sustained operation.

**Key Lessons from Private and Communal Property Rights**

1. There is a role for both private property rights and common property rights in any resource system; both provide different benefits to participants. Neither approach by itself ensures equity, efficiency and sustainability by itself. However their effectiveness is influenced under certain social and institutional settings, and by specific attributes of both the resources and participants involved. No property-right regime works equivalently in all types of settings. Private and communal rights regimes often co-exist in the same setting.

2. Both private and common property rights require emergence of effective rules to establish, maintain and enforce such rights. In the absence of effective formal or informal agreements and low-overhead monitoring (or low transaction costs for enforcement), rent-seeking behavior can be expected by both participants and rulers.

3. A useful distinction between common property and open access regimes enables one to recognize the role for community norms and mechanisms to manage or restrict shared resources. Open access does not ensure that resources will be well maintained and conserved; communal mechanisms can support monitoring and resource sharing.

4. It is important not to focus on any one notion of property right but consider different classes of rights (such as access, ownership, proprietorship) that individuals or collectivities may hold. Any combination of these rights allows different participants to utilize and manage the resources depending on their skills or needs and the limited availability or value of shared resources. A system of such differential rights may emerge informally or formally, and defines the relationship and responsibilities of participants.

5. In the absence of physical or institutional mechanisms for risk sharing, communal property arrangements may allow participants to establish productive ways of utilizing and governing shared resources.

6. The legitimacy and facilitation offered explicitly or implicitly by the institutional setting within which the resource system is embedded, increases the likelihood of the property rights system being more effective.

7. An effective property rights system requires participatory design and implementation to ensure participants perceive it as being fair and legitimate, while taking responsibility to maintain, monitor and enforce it. However, introducing notions of quantitative and transferable rights may undo common norms and understandings that allow such communal systems to operate. Hence there is a risk in formalizing a property rights regime without examining its influence on existing community norms.

We will consider these property rights issues in the context of design innovation among online communities later in this section.

**2.2.2 Emerging Politics of Intellectual Property Rights in the Public Domain**

The historic notion of property rights as embodied in mechanisms to protect natural resources such as land are clearly at play today in the emerging notions of intellectual property as well. In a renowned essay, James Boyle [2001] likens the current intellectual property regime to that of “The Second Enclosure Movement”. He refers to the first English Enclosure Movement from the 15th to 19th century, which was an effort to turn common lands into private property. The
Enclosure movement had both positive and negative effects. Some considered it to be a means for inefficiently managed common land to be transferred to private owners who had better incentives to invest, maintain and make the land more productive. “Strong private property rights and single entity control avoid the tragedies of overuse and underinvestment”. However, others would claim that enforcing such property rights imposed devastating costs on some segments of society such as converting freeholders who farmed on the lands of generations into debtors and seasonal wage laborers, disrupting traditional social relationships and communal norms, and as Ostrom points out, loss of many communal mechanisms to ensure conservation and access.

Boyle suggests that we are now in the middle of the second enclosure movement, one he calls “the enclosure of the intangible commons of the mind” where previously common and uncommodified intellectual property is being enclosed using formal property rights like copyrights and patents. A classic example is that of human genome where the state argues for extending property rights to ensure investment and commercial incentives to produce new drugs and gene therapies, while opponents argue that the genome should not be owned as it is the “common heritage of humanity”. In addition some critics have argued that a monopoly over the property rights held by private companies and individuals in areas such as the human genome also introduces “bottlenecks and coordination costs that slow down innovation”. Heller and Eisenberg [1998] refer to such bottlenecks caused by property rights as the transaction costs that create “The Tragedy of the Anti-Commons”. Boyle points out that rather than focus on the popular rhetoric and naturalistic assumptions, economists concentrate on the “efficient allocation of rights” necessary to spur innovation.

Natural Resources vs. the Intellectual Commons

One can notice this expanded process of enclosure in many different domains – business method patents, software patents, increasing restrictions on digital media (from the recent Digital Millennium Copyright Act), regular extensions of copyright terms by the US Congress, European database protection, and overall it seems that patents are being applied for ideas that previously would have been considered common facts, public knowledge or simply unpatentable. Each of these clearly erodes the ability for production of ideas in the commons.

However, Boyle points out three main distinctions between the natural resource commons and intellectual commons that should allow us to question many of the assumptions about property rights today:

1. **Non-Rival:** While utilization of land is generally mutually exclusive and causes degradation or scarcity form overuse, the ideas, designs and information (like gene sequences and MP3 files) is generally “non-rival” i.e. usage by one user does not interfere with another.
2. **Non-Excludable:** Creators cannot easily exclude others from using their creations (information and design) as current network technologies allow such access and usage with nearly zero marginal cost. Hence, the argument is that intellectual property rights are necessary to provide incentives for creation and allow creators to recover costs.
3. **Derivative:** Increasingly information goods (and even hardware designs) are often developed on the basis of existing information or designs, even including those fragments in their production. Boyle states that every potential increase of protection raises the cost of and reduces access to those raw materials.

Hence, the key problem in the intellectual commons is that of incentives, costs and conditions to create the resource rather than its overuse, unlike the physical commons of the first enclosure movement. Here Boyle, makes a critical argument (which is also echoed by Benkler in his notions of “Peer Production”) that although network technologies like the Internet lower the cost of illicit transfer, copying or usage, “the same process also lowers the cost of production, distribution, advertising and dramatically increases the size of the potential market. Is the “net” result, then, a loss to right-holders such that we need to increase production in order to maintain a constant level of incentives? A large, leaky, market may actually provide more revenues than a small one over which one’s control is much stronger.” Hence with online access, search and archiving, it
seems in many regards that the strong protection of content can be counter-productive to both the process of innovation and potential economic payoffs. Intellectual property protection becomes an automatic response as a solution to the problem of preventing access or protecting potential revenue, rather than as a means to create conditions for innovation and new models for recuperation of creative efforts. Boyle states that paradoxically “protection of the commons was one of the fundamental goals of intellectual property law” and that the “burden of proof should be on those requesting new rights to prove their necessity”.

**An Anti-Enclosure Movement: Environmentalism for Intellectual Property?**

There is evidence of a counter-movement now, shall we say the “Anti-Enclosure Movement” for intellectual property rights pushed by both Free Software and Open Source advocates lead by hackers like Stallman, Trovalds and Raymond as well as academics and legal scholars like Boyle, Benkler, Samuelson, Littman, Lange and Lessig. Instead of merely criticizing the costs of intellectual property protection, the rhetoric is shaped by a defense of the “public domain”. There are 3 main philosophical approaches used in this defense: 1) Scholars frequently cite the *constitutional protection* afforded to the public domain, in arguing against extension of copyrights and patents. 2) David Lange [1981] argues “the recognition of new intellectual property interests should be offset today by equally deliberate recognition of *individual rights in the public domain*.” 3) Benkler focuses on the role of the public domain in *information production and free use* i.e. being uncontrolled and costless. Lessig [2001] refers to the commons as a free resource, which is “not necessarily zero cost, but if there is a cost, it is neutrally imposed, or equally imposed cost.”

Finally Boyle notes that the notion of freedom invoked in intellectual property rights ought to be one of “non-discriminatory access”; maintaining unprivileged innovation by removing monopoly control rather than seeking costless or “free” access.

An important point that Boyle and Samuelson [2001] make is that despite the rhetoric of free and open source software movements about the public domain, free software under General Public License (GPL) is legally based on property contract. The terms of fair use, access and ability to make changes to Free Software under GPL agreements relies on intellectual property rights. “The free software movement attempted to build a living ecology of open code, where the price for admission was your commitment to make your own incremental innovation part of the ecology too.” Though free software does not fit neatly into the “total freedoms” expected in the public domain, the social agreements are consistent with the notion of communal property norms and mechanisms (as mentioned earlier in the work by Ostrom and others). Hence it is important to recognize that in most cases cooperative action and property rights in the network commons can be effective, not due to free unrestricted access, but by establishing communal norms for access, distributed creation and management of the information resources and cooperative products. These norms must be defined and/or adopted by the community itself over time to make the peer production an effective and sustainable enterprise.

Boyle shows that there are many different conceptions of the “public domain”, just as there are many different “properties”. The notions of “free”, “public domain”, “commons” and “enclosure” are not always consistent with each other, having different meanings in different contexts. For example Boyle states “It may be that the commons is constructed around the twin notions of preventing monopoly control over network protocols in order to preserve innovation, while still allowing for the type of collective management that will avoid a tragedy of the commons.” This is an important aspect to understand, as it influences the visions and nature of cooperative arrangement pursued by different communities with different interests. So there should be a role for multiple visions and theories on the public domain. However, there are some clear overlaps in the common ideals pursued in all such notions and greater coherence among the shared goals is useful. In this regard, both Boyle and Samuelson argue for a “new politics of intellectual property” to protect the public domain, analogous to the role of the Environmental Movement in conserving our natural domain. Inventing a concept of the “environment” in the 1960’s enabled a powerful movement to emerge from diverse interests, to lobby cooperatively to protect their distinct visions of the environment. Boyle and Samuelson push for a coalition of scholars, authors, artists,
innovators, private and public institutions to ignite a similar movement to promote open and non-discriminatory policies for the public domain and balanced intellectual property laws.

This brings into question: what is the role for online communities like ThinkCycle to adopt novel and progressive policies to support their evolving vision for design innovations in the public domain? And to what extent this can influence property rights awareness and activism in other communities? We will consider the implications in concluding sections.

2.2.3 Rethinking Property Rights for Small-scale and Subpatentable Innovation

Much of the debate on intellectual property for patent protection vs. public domain focuses on “breakthrough” R&D innovations with big market players and high commercial stakes (such as in biotechnology). However, there is little discussion of how to deal with small-scale innovations among grassroots innovators or small industries, which are not always considered patentable. Many such innovations emerge in university research, cottage industries, and particularly in rural or non-academic settings by grassroots innovators. What set of policies can stimulate and protect small-scale innovation while supporting access and peer production in the public domain?

Reichman [2001] highlights these concerns and potential approaches towards what he calls “the puzzle of grain-sized innovation” particularly in the context of small-scale industries and developing countries. He suggests that there has always been a perception that if innovations can be kept proprietary or under legal cover, innovators can expect a period of “natural lead time” during which they recoup their effort and investments through licensing or manufacturing. Since the early industrial revolution, there has been concern that once products are distributed to the market, competitors can easily imitate them without having to incur R&D costs of their own. The legislative response has typically been a strengthening of exclusive property rights through patents and copyrights, providing an artificial lead-time. Reichman feels that an expansion of “poorly conceived and overly protective intellectual property rights may progressively discourage investment in subpatentable innovation across large segments of the global marketplace.” There is typically no assessment of the unacceptably high social costs of exclusive property rights from the diminished opportunity for small firms and innovators to compete.

Property Rights vs. Liability Mechanisms: The Green Tulip Problem

Reichman previously studied why local design industries in some countries with relatively weak protection (like Italy) had done better than those with stronger protection (like France). He found that there was often a “recurring cyclical movement between states of perceived underprotection and states of perceived overprotection”, where countries periodically swung between adopting weak to strong protection over a two hundred year period. The key problem Reichman found was that in all these regimes, small-scale innovation was often dealt with “by means of a property rule, whereas the problems entrepreneurs actually faced resulted from the failure of a liability rule.” Reichman believes that a properly devised liability rule better addresses the problem of follow-on innovation for subpatentable designs, with fewer social costs. He demonstrates this using a hypothetical scenario called the “green tulip” problem.

In the hypothetical problem proposed by Reichman there are three firms that breed tulips: Breeder A develops a green tulip for the first time, however it is unable to have commercial success. Breeder B combines this variety and breeds a red, white and green tulip; this product is commercially successful with consumers. Finally other breeders, designated as Breeder C use both A and B’s varieties to develop an array of different tulips. The question in this scenario is how different IPR regimes deal with small-scale innovation i.e. how the first comer (A) is able to recoup her investment while allowing others to compete with follow-on innovation. It is assumed that the green tulip is a small grain-sized innovation that is easily replicable by others and subpatentable (i.e. cannot be patented due to existing standards regarding nonobviousness). Reichman then considers how the puzzle is resolved within three different patterns of IPR:
**Raw State of Affairs:** Here there are no exclusive property rights and free competition is allowed, hence Breeders B and C may easily profit from A’s original innovation. If Breeder A is unable to make his product commercially viable, others can potentially take the market with no means for A to protect or recoup her R&D investment.

**Copyright-Like Regime:** Breeder A is able to take up a weak form of intellectual property protection based on the copyright model. This does not necessarily deny B from developing a derivative product; in most cases courts allow free competition where others provide value-added contribution by investing their own time and effort (whereas a direct imitation would invoke infringement claims). So Breeder A has a very weak claim of relief under copyright-like regime, hence she may not be much better served in terms of recouping her investment under this regime either.

**Patent-Like Regime:** In a regime modeled around patent protection for plant varieties (such as utility or design protection laws), Breeder A could invoke a stronger right to deny unauthorized follow-on innovation from others, and hence retain lead time or competitive advantage. Here Breeders B and C will require a license from A to develop their follow-on products, having to negotiate terms and pricing while they are uncertain whether they can make any revenue from their potential innovations. Breeder A can choose to deny licensing to others or do so selectively to maximize her own competitive advantage. If Breeder A’s initial product was not commercially successful and other breeders are prevented from follow-on innovation by having to make their own high-risk R&D investment or licensing/infringement barriers, then its quite possible that follow-on derivatives of A’s tulips are never successfully introduced in the market. Other breeders would seek to develop their own original tulip variants to take advantage of strong patent-like protection. Hence there is little incentive for follow-on innovations and subsequently commercial successes, aggravated by additional risks and transaction costs involved. This leads to lack of novel products or high costs for consumers and a denial of technically beneficial knowledge among the entire breeder community, resulting from access and lack of new industry-wide investments and follow-on research.

**Social Costs of Exclusive Property Rights on Producers and Consumers**

This scenario can be easily mapped to the case of generic drugs or small medical innovations for critical treatments in developing countries, and one can see the need for supporting follow-on innovations and access to novel and affordable products for poor consumers. The scenario shows that poorly conceived intellectual property regimes can not only hamper innovation among producers but also induce high social costs on all consumers. Conferring a monopoly to any one producer through exclusive rights leads to many flawed economic outcomes. As Reichman explains “While the public stands to benefit from the green tulip innovation (despite the tepid initial consumer response), solving the free-rider problem by misbundling exclusive property rights imposes burdensome transaction costs on the relevant technical community, frustrates entrepreneurial initiative, and saddles the public with the social costs of misdirected, top-down incentives that deny equally capable second comers access to inputs from the public domain.”

Another issue is that most exclusive property rights do not take into account the role of the community of producers and innovators in the process of developing the innovation from their combined knowledge in the area. While protecting and recognizing individual innovators, these approaches “undermines the community own interests by artificially restricting access to the public domain interests on which it collectively depends” as both Boyle and Benkler have previously suggested about the role of peer production. Reichman goes on to say that “by rewarding individuals with strong exclusive property rights for routine applications of the community’s technical know-how to industry, the system tends to make that shared know-how artificially scarce” leading to higher transaction costs and ultimately greater social costs to both the community of innovators and consumers (for these small subpatentable innovations). Finally, the overall outcome of such protective regimes is that community knowledge is divided up into smaller parcels withdrawn from the public domain, leading to greater barriers for knowledge-sharing and small-scale innovation.
Compensatory Liability Scheme for Subpatentable Innovations

A solution to the green tulip puzzle would need to fulfill seemingly contradictory requirements: 1) allow innovators to recoup their investment, 2) prevent others from free-riding without contributing, 3) avoid barriers to entry for follow-on innovations, 4) allow dissemination of knowledge in the public domain (or within the community of producers). Reichman believes that some form of liability principles rather than property rules provide a more appropriate solution. A liability essentially system obliges “second comers to pay equitable compensation for borrowed improvements over a relatively short period of time.” Simply stated in a liability principle, other breeders must compensate Breeder A for use of her know-how during a specified period of time only (relatively short), while Breeder A cannot deter others from using her innovation under those terms. Finally Breeders C must compensate both A and B during that time. Compensation is based on the value added by follow-on innovations (a sliding scale of modest % royalties). At the expiration of the period of protection, the small-scale innovation would come into the public domain. This creates a functional equivalent of natural lead-time rather than an exclusive property right, encouraging compensation, competition, follow-on innovation and minimizing free riding.

Implementing such a compensatory liability scheme requires: 1) a subject domain for which the scheme is applied that Reichman calls an “industrial compilation”, 2) flexible standards of novelty (to protect subpatentable innovations), 3) consensus on a period of artificial lead time allowed for a specific “industrial compilation”, 4) national online registry system for tracking claims, 5) arrangements for dispute resolution and infringement (built into the online system to some extent). Hence within a specific industry like plants, handicrafts, digital music, or say innovations for the underserved, there needs to be agreement on the specific nature of the liability scheme adopted. In a sense it constitutes a “third intellectual property paradigm” that can be further developed while it coexists with existing patent and copyright regimes. The key implication of the liability approach is its focus on the community of producers as a whole (within small industries) rather than any individual innovator, encouraging investment, exchange, compensation and arbitration within the community, while enriching know-how in the public domain over time. We later consider the role of such a liability scheme for distributed communities in digital networks.

2.2.4 Challenges of Property Rights for Grassroots Innovators in Developing Countries

While the notions of intellectual property rights we have considered so far apply broadly to innovations in most settings – high-technology, industrial, academic, small scale manufacturers and innovators – however, there are many specific constraints and problems that arise in the context of grassroots innovators and communities in developing countries.

Contested Domains: Private, Community and Public

There are clear parallels between the approach towards property rights over natural resources, and that of individual and community knowledge in developing countries. Prof. Anil Gupta [2001] has suggested that these “Contested Domains” of knowledge, resources, rights and responsibilities must be clearly understood, along with the role of effective incentives for reciprocity, social equity, conservation and innovation. In contrast to the dichotomous notions of property rights, Gupta indicates there are contested domains among private, community and the public domain. One notes in written works that western scholars often assume the knowledge and resources in developing countries as belonging within a community or part of the public domain. The role of independent innovators and individual rights (particularly of poor rural innovators) is often overlooked or under-represented. Though individuals regularly derive knowledge, resources and insights in their community settings and while boundaries between individual and communal rights are not clearly demarcated, Gupta strongly advocates for a need to recognize individual creativity and provide appropriate incentives for innovation, sharing and conservation.

Gupta has often stated that policies that allow individual and community knowledge to be easily placed in the public domain without prior informed consent and reciprocal benefits, are not just problematic but “rob the poor of the only thing in which they are rich”. Hence, there seems to be a threat to the intellectual property rights of grassroots individuals and communities, not only from
exploitation by the state and multinational corporations, but also paradoxically from the increasing drive towards open intellectual property regimes among scholars and activists arguing for the public domain. How does one resolve these seemingly diametric interests that each strive for the public good?

Gupta states that knowledge produced by individuals or groups may be diffused locally and characterized as community knowledge, while diffusion outside leads to knowledge in the public domain. However, even within the individual or community knowledge “there may be elements which are restricted in scope or in terms of accessibility while others may be in the public domain” while other aspects may be kept entirely confidential and only accessed with restrictions. Another important factor mentioned by Ostrom is that in many indigenous communities, heritage and knowledge is not viewed in terms of property but as responsibilities, which are not commodified like property rights. Hence, it is not feasible to apply any one notion of IPR across all forms of individual or community knowledge. Gupta [1995] shows that much of the “contention emerges when the producers and users have unequal access, ability and assurances” in these overlapping domains of private, communal and public knowledge. However, a goal is to ensure that there are mechanisms and incentives for innovation, conservation, and attribution to innovators, while non-discriminatory (and perhaps regulated) access to such knowledge to benefit other communities.

**Supporting Intellectual Property Rights for Grassroots Innovators**

In his writings, Gupta points out several challenges and approaches for IPR in such settings:

1. **Formal vs. Informal Knowledge:** To provide IPR protection one has to characterize grassroots knowledge in terms of existing formal scientific knowledge, to help establish novelty and non-obviousness claims. This is rather difficult and requires a greater engagement in grassroots innovations by the scientific community.

2. **Documenting Oral Knowledge:** Very often rural innovation and traditional knowledge is disseminated orally and not documented in written form, hence verifying prior art for infringing patents becomes problematic in such cases. The Honey Bee initiative\(^{22}\) has been documenting grassroots innovations for over 10 years through a network of volunteers, and disseminating many through printed publications in local languages (with the permission of innovators).

3. **Grace Period for Grassroots Innovations:** Recent disclosure of knowledge by innovators (to external parties, researchers or in the public domain) should not pre-empt them from seeking property rights. Not having awareness of IPR and lack of resources to invest in their enterprise suggests the necessity of “special grace period” for protection and to extend their lead-time.

4. **National and Global Registries of Small Scale Innovations:** Preventing patents by companies on traditional and contemporary knowledge in communities requires a mechanism to register all prior and recent innovations in a easily searchable and verifiable form. Digital libraries for registering traditional knowledge have been proposed by many scholars, and Gupta cites some efforts undertaken by the Government of India. A global system would be very useful for resolving conflicts in claims made by patent applications and provide an affordable registry for innovators. Many groups such as the Third World Network [Nijar1996] have proposed Community Intellectual Rights (CIR) and mechanisms like “registry of invention”, while SRISTI [Gupta1995] has proposed an “International Registry” with a focus on disclosure rather than examination of novelty and non-obviousness. This approach reduces filing costs by placing the burden of verification at the time of patent infringement or conflict. The CreativeCommons\(^{23}\) was established by MIT faculty Hal Abelson and Law faculty from Stanford, Harvard, and Duke. It provides a

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\(^{22}\) [http://www.sristi.org/knowledgetrign.html](http://www.sristi.org/knowledgetrign.html)

\(^{23}\) [http://www.creativecommons.org](http://www.creativecommons.org)
novel online mechanism to register and use copyrights for creative works. One could consider a similar approach towards patentable or subpatentable design innovations.

5. Collective Management of IPR: Gupta suggests a “collective management system” for institutional support of small innovators to reduce transaction costs for seeking protection. Though Gupta assumes that the primary role is for support of patent applications, however it seems that such a collective system not unlike the “industrial compilation” mentioned by Reichman could provide an array of mechanisms like and support for managing IP within an industry, like registry, licensing schemes, conflict resolution, patent pooling, knowledge sharing etc.

6. Protection Schemes for Small Scale Innovations: Gupta points to the need for a national patent system for small innovations where short-term protection is granted (8-10 years) within 3 months, with a maximum of 5 claims and small fees. To some extent this is not unlike Reichman’s notion of compensatory liability protection for “subpatentable” innovations – the key distinction is one of seeking exclusive property rights by filing patents in the current IP regime vs. compensation and lead time by developing an agreement regulated and enforced by countries or the industry involved.

Gupta argues that notions of intellectual property must be examined within the context of intellectual capital (social and technological interactions), natural capital (biodiversity and resources), social capital (communal and institutional arrangements), and ethical capital (norms of transparency, accountability, reciprocity and equity). Each of these influences how intellectual property is perceived and governed; they are clearly different in diverse communities. To be effective and equitable, any IPR policies proposed must take into account such aspects.

2.2.5 Summary: Supporting Access, Rights and Liabilities for Innovation

We must examine questions about intellectual property rights within the context of private, communal and public spheres – there are different incentives, responsibilities, norms and mechanisms that govern the relationship of innovators to each of these spheres. Hence no one notion of intellectual property can clearly satisfy the distinct needs within each sphere. Appropriate policies must be carefully devised within such contexts, while recognizing the interrelations among them. To be effective such policies must be developed with the participation of innovators, communities and stakeholders, and facilitated by institutional settings within which the systems operate. Beyond these general principles, a number of common concerns and approaches are worth addressing for dealing with intellectual property rights:

- Different scholars have argued for distinct rationale to protect knowledge in the public domain, community and individual innovators. Any IPR policy must address the impact and outcomes from subsequent changes in each of these spheres.
- Some form of intellectual property protection should not be considered the de facto solution for all problems related to access, compensation and dissemination of innovations.
- It is important to establish communal norms for access, usage and management of intellectual resources, preferably by developed and enforced by the community itself.
- It must be recognized that there may be different classes of rights and forms of access, usage and management of intellectual resources at distinct times for different parties.
- Compensatory liability schemes rather than exclusive property rights may be better suited for dealing with subpatentable innovations in particular industries.
- Institutional support and facilitation is necessary for innovations both from the industry and state as well as from the scientific community to provide legitimacy and enforcement.
- Networked technologies today both lower transaction costs for both illicit use and transfer as well as that of production and distribution. In addition online registries provide a global means to make all parties and intellectual claims more accountable. Hence, distributed networks and online databases can play a key role in shaping IPR today.
One can characterize intellectual property regimes along two main dimensions of the social arrangements that emerge (implicitly or explicitly) among participants:

A. **Sphere of Influence** (private, communal and public)

B. **Attributes of Social Contracts** (access, protection, liability etc) in each sphere

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We can examine how specific intellectual property regimes and mechanisms lineup in this typology such as GPL, Free GPL, Patents, Patent Pools, Copyrights, Trade Secrets, Compensatory Liability, and so on. Recognizing how specific systems deal with attributes of social contracts within each sphere of influence may provide greater insight into rethinking appropriate IPR measures and their effects. Note that this is a preliminary typology, additional attributes should be added based on the nature of system being examined and analysis desired.

This approach can serve as one of the analytic tools used to better understand the inter-related notions of IPR emerging from studies of collaborative design in online platforms like *ThinkCycle*. In summary, one needs to understand the complex nature of social incentives mechanisms, communal norms and intellectual property rights in the specific contexts of social and institutional settings, to develop models that support *cooperative innovation in the commons*. 