

An Introduction to the Digital Commons: From Common-Pool Resources to Community Governance

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Abstract

This article proposes an introductory analysis of digital resources and commons-based peer production online communities with the framework of the common pool-resources. Trying to go beyond the classic economy dichotomy between physical resources scarcity and informational resources reproducibility, the approach allows to focus not only on the nature of the resources, but mostly on the governance by the communities to produce resources which remain available for all to share and build upon, while avoiding risks of pollution, degradation, underuse or enclosure by the market.

Keywords

Internet, digital resources, digital commons, knowledge commons, online communities, commons-based peer production, common-pool resources, enclosures.

Introduction

This article proposes to explore how the theory of the commons can be applied to the digital commons, a subset of internet, virtual and knowledge resources. The internet constitutes a radical technological transformation that allows duplication and distribution of texts and audiovisual works with near zero marginal costs. In that sense, digital information can be considered as a public, non-rival and non-excludable good. But two approaches of digital information have been developed in parallel since twenty years ago (Aigrain, 2005). Information can also be commodified and artificially enclosed, even in a digital format. That is the model followed by the industry to protect production investment, while some online communities use another model, the commons-based peer-production (CBPP). We will question whether this approach of the digital commons can be treated as a common pool resource (CPR) considering the investment and governance of communities to produce, share and protect digital resources. Rather than leading an extensive analysis, we include descriptions of selected resources and communities exemplifying governance models and risks of degradation and enclosure, in an attempt to contribute to the dialog between research communities of the digital CBPP and of the CPR (Hess, 2000).

With the development of the internet in the last twenty years, intellectual property has been adapted to the internet under political pressure from private actors from the knowledge and entertainment industries, with the intent of enclosure, using law and technology to restrict access to information. In the meanwhile, actors building on the networks' distributed technical capabilities have been putting an emphasis on the discourse of freedom, open access and sharing

(for instance Barlow, 1996). By leading practical experiences of collaborative online creation, they gave reality to the notion of digital commons, which they defined as resources shared under an open licence. Nonetheless, such digital commons can still be subjected to commodification, degradation and enclosure, like the physical commons (Hess, Ostrom, 2006). Wikipedians, free software developers, artists or researchers who upload their photos or articles in open repositories allowing others to reuse their works, are example of CBPP. Their communities adopt specific governance rules to organise production, access and maintenance (Fuster Morell, 2010). The architecture of the internet, internet protocols and technical norms, can also be considered as a digital commons, developed by open communities of computer scientist, engineers and technicians; and coordinated by the IETF (Internet Engineering Task Force) and the W3C (World Wide Web Consortium), preserving network neutrality against private appropriation for all users to develop private and public activities (on the Internet as Commons, see Hess, 2000 and Hofmokl, 2010).

In this paper, we are going to describe the economic characteristics of digital and information resources (1.1) and the governance models of digital production communities (1.2). The market option (1.2.1) can lead to the enclosure of digital resources and their underuse, the tragedy of the anticommons (1.2.2). The commons-based peer production model (1.2.3) is based on alternative IP regimes. In order to assess whether digital commons, the digital resources produced by commons-based peer production communities and distributed under open licensing terms referring to the commons (Creative Commons, hereafter CC), can also be qualified as CPR, we try to apply the eight design principles coined by Elinor Ostrom (Ostrom, 1990) to selected communities (2.1 to 2.8) and discuss how the commons approach can be applied to global resources (3.).

1. Landscape

1.1 Characteristics of digital information resources

Digital resources are a non-excludable, non-rival public good (Samuelson, 1954). They can be copied and distributed with a marginal cost near zero. The marginal capital one needs to create digital resources or participate in collaborative online activities is also near zero as the infrastructure is already in place for work or leisure activities. Computing and the internet is a kind of global copy machine where the document economy knows a form of abundance. These economic characteristics provide the framework for peer production in the cyberspace (Benkler, 2004), coupled with available computing resources and collaborative tools (mail, mailing lists, distant word processing software, wikis and online open repositories, see section 1.2.3).

These conditions help internet pioneers to change some rules in the document production and consumption area, to pronounce phrases like “information wants to be free” and to put in place sharing systems. The free software movement was the first to explore those possibilities, by coining the freedom of sharing. Since its inception, the internet mainly propagated in the academic world, where it crossed a culture of sharing, as described by Robert K. Merton (Merton, 1942). For mertonian scientists such as Stevan Harnad, Peter Suber or Jean-Claude Guédon who help create the scientific Open Access movement, the internet is the ultimate tool

for opening access to scientific literature (on research commons, see for instance Reichman, Uhler, 2003).

But on the other hand, as far as knowledge and culture are embedded in digital documents, they are confronted with new enclosures. With digital rights management systems (DRM), producers can block usage and sharing, sending encrypted documents that need a special key for the receiving computer to read the content. This is problematic for authorised use as private copying or library work, and even in the case of a consumer changing its computer. Digital information can also be lost and erased. Digital web archives are not complete, and it is not an easy task. For printed documents, libraries play a critical role to ensure club access, for local patrons as well as distant ones through the Universal Availability of Publication program¹ that build a network of libraries long before digital networks. What was once possible for printed books is now sometimes less easy for digital documents in many areas, because of copyright laws, restriction to limitations and exceptions for education and research and also commercial practices by publishers, and surprisingly by academic and scientific publishers. In that context, libraries exchange subscription with local copies to subscription via connected online access. Digital documents are also distributed using databases, and a lot of websites use locked access to control usage. So, with the extension of the commercial internet, a new conflict arises between the very nature of digital document sharing and the economic and legal organisation of document circulation.

To ensure open access and sharing, we see the rise of many services (Internet Archive, The Pirate Bay, YouTube or SlideShare). There are also new technological means (as P2P protocols, or software that helps jailbreaking of screwed documents) that help circumvent the blocking space imposed by some publishers' business models. To help those creating from the ground up documents that can legally and practically be shared, some movements write open or free licences that any producer can add to its creations, like the CC or the Open Data Commons Licences. When personal and collective works are created using those licences their creators can ensure open and wide access, and also large participation of concerned users to extend and maintain those informations. If Wikipedia is the best known, we can look at OpenStreetMap or Telabotanica communities for examples of the same kind of paradigm.

So digital resources resort from a wide range of legal and economic characterisation, and can be considered either as CPR, as public goods, as club goods with restricted access, and as private goods with a digital market rising, as in the music industry. The first ideas of social and economic changes led by digital technology fall short. It is not the very nature of digital resources that are central, but the governance options.

1.2 Governance of digital resources and communities

As digital resources can pertain to all natures of economic goods (private, public, club and common-pool resources), the provision of production platforms, the production and the

¹ UAP is a professional program, launched by IFLA (International Federation of Library Association) in 1973 that stipulate that any patron anywhere can gain access to any book through a global interlibrary loan service. This is a material world first program to guarantee access to knowledge worldwide.

distribution of digital goods can be governed through different rules and intellectual property regimes: the market, the existence of a vibrant public domain, and the commons. The market option (1.2.1) has seen large developments in the last twenty years, leading to an enclosure of the public domain (1.2.2). In the same time, CBPP communities (1.2.3) have chosen alternative ways to organize the production and share the knowledge.

1.2.1 The market option

The market approach to produce and distribute digital resources is based on the legal tool of copyright, which has been developed to protect informational resources at a time their distribution was not networked but required a tangible support, such as a book or CD, which usage is rival and excludable. Copyright is the branch of intellectual property law allowing rights holders to create artificial scarcity by controlling the reproduction and the distribution of goods that could otherwise be copied, exchanged and reused at their marginal cost, which is near to zero in the case of digital resources. Establishing a temporary monopoly on the reproduction, the modification and the distribution of works is a solution that has been used since the development of copyright and its application to works of art and of information, long before the digital era. Nevertheless, even if conditions have changed, the same solution continues to be applied by creators and producers who reserve the exercise of their rights in a comparable way both offline and online.

Governance of digital resources through the market option relies on a vertical industry, where producers and users are separate, distinct entities, which helps defining private property boundaries. The production and distribution of many digital resources falls under this category. The market option may be a good choice for such goods, for example the publishing industry or cinema. But even for those industries, copyright foresees limitations and exceptions for the benefit of users to authorise collective use (education, libraries, research...) and some private usages such as private copy, but these are jeopardized in the digital era. The extension of streaming, where digital document can be accessed through a subscription basis (or premium models that allow free access only for a short range of the catalogue to non subscribers) is one of the new business models that try to prevent private copying and sharing and keep all usages within the market sphere, coupled with legislations which try to ban or monitor private exchange practices.

1.2.2 Intellectual property and the second enclosure movement

By controlling access and reproduction, the market approach re-establishes artificial scarcity and excludability. James Boyle (Boyle, 2003) has been qualifying the process as a “second enclosure movement on the intangible commons of the mind” by analogy with the first enclosure movement, which had seen the installation of barriers around the physical commons in England. The introduction of fences by private landowners led to prevent the largest part of the population to access to the land, depriving them of a substantial part of their living resources, for instance through gathering hay or grazing livestock on open fields.

The second enclosure movement is a metaphor illustrating a similar threat on traditional practices to access to knowledge and information, which are being jeopardized at the digital era. Fences legally, technically or commercially built around digital resources are the new enclosures.

For instance, the access-only market models do not reproduce the functions of a library or private lending. Usages of copyrighted works that were previously unregulated can no longer be executed on the digital version of the same good available in the market online options. In addition to the development of market-based private regulation by contract, intellectual property laws are being extended in duration and scope, with the protection of items which were previously uncovered (e.g. databases in Europe). This new form of control on usages through copyright law and contractual terms of use is done to the expense of the public domain (on restrictive terms of use by public institutions such as museums, see Dulong de Rosnay, 2011). Also, with the development of peer-to-peer networks making it easier for users to share and download digital files, thus bypassing the market option, copyright industries started to develop technical protection measures, digital fences they apply to their files and sometimes embed within the reading material or the rendering devices, being a software or a hardware DVD player.

In many circumstances, the market only solution can lead to an underutilisation of knowledge (Xuan Li, 2009), which may not reach the beneficiary of an exception or a limitation to copyright such as a library patron, a student or an educator. There is a market failure and an underuse of informational resources because of technical, commercial and contractual barriers erected in the digital world, also called a tragedy of the anticommons (Heller, 1995). Another problem occurs with the market governance model is the one of the second-hand creation of derivative works, where some users of a published work use extracts to incorporate in their own projects. Remix music, video mash up or documentaries fall under this type of work that rely on access and reusability of previous works and are limited because of the legal enclosure of pre-existing material (Lessig, 2004).

Contracts, being terms of use of market services or rules embedded in DRMs, are being used extensively to govern the usage of digital files, in a way which was not possible in the analogue world where all private activities were not submitted to copyright. Due to the nature of digital information, every action led on digital goods requires a reproduction of the file and therefore triggers copyright. In the analogue realm, reading a book or lending it, in a library or privately, doesn't trigger copyright. These acts are unregulated and part of a functional public domain of users' rights. But by adding legal or technical contracts under the form of DRMs to ebooks or mp3, the market has been imposing limitations through private means, therefore restricting the field of traditional prerogatives of users, such as occurs to the farmers in England of the XVIIIth century. The metaphor of "the right to read" (Stallman, 1997) has even been used to denounce this overreaching expansion of copyright monopoly and the limitation of traditional user rights (see also Lessig, 2004).

1.2.3 Commons-Based Peer Production communities

Online communities have also been able to take advantage of the digital environment features to develop other forms of production and collaboration than the market option: the commons-based peer-production or CBPP (Benkler, 2006). These institutions for collective action are structured

online to create and distribute digital resources under a legal regime using the copyright system not to restrict usage, but on the contrary, to ensure access through installing a regime of collective ownership of the digital resources that are produced collectively.

Most famous examples of CBPP are Wikipedia and the free software communities. All use free or open licenses based on the principle of copyleft, granting free access to all users, and requiring those users who modify the work to release the adaptation under the same licensing terms. These contractual tools have been developed by users who were noticing an erosion of the public domain. Such as the market option, they are using a contractual regulation, but in order to maintain the digital resources in the commons or as public goods, instead of turning them into pure private goods as the market option. Many open licenses exist (which could lead to an anticommons if they become incompatible, see Katz, 2006 and Dulong de Rosnay, 2010) and two standards have been emerging: the GNU GPL for software and the CC Attribution ShareAlike license for non-software works (other informational goods covered by copyright such as text, music, pictures, video, etc).

The GNU GPL license has been created by Richard Stallman and Eben Moglen, and is the originator of the free software movement. In order to avoid enclosure of products that cannot be modified, it is necessary to have access to the source code, which is usually impossible according to the contractual terms of use of proprietary software. Free software licenses constitute an alternative model of licensing software code in order to guarantee free, unrestricted access to the source code to all. The copyleft principle also guarantees access to the downstream modifications, preventing any attempt of private appropriation of the software because users have to redistribute their modifications under the same license.

The CC set of licenses also authorize anyone to copy and distribute the work at a minimum for non-commercial purposes, with different options governing the modifications. A team of American law and computer science professors developed them at the time of the Eldred vs Ashcroft Supreme Court decision (Eldred, 2003). Lawrence Lessig represented Eric Eldred attacking the constitutionality of the latest copyright term extension law, a legislative measure symptomatic of the second enclosure movement. Losing the case prompted them to develop a voluntary way for authors to not fully exercise their copyright and instead of following the market option, to enrich voluntarily the creative commons or a “semi-commons” (Pallas-Loren, 2005) of digital resources with their own works.

The core of the internet, the IETF standards, those technical standards which rule the interoperability of the worldwide network, can also be considered as commons-based in the way they are developed by a voluntary, loose community of engineers and commonly shared as an infrastructure by all internet users for different activities without discrimination.

2. Method: Application of the Design Principles of Common-Pool Resources institutions to selected cases

Elinor Ostrom designed a set of eight principles (Ostrom, 1990) for long-enduring CPR. The purpose of this section is to analyse whether these principles can be applied to recent digital resources that have been created by CBPP communities.

These resources are produced thanks to an entanglement of CPR (Internet protocols) and private goods (the physical layer). Applying the design principles may (or may not) help to qualify these cases of digital commons, to improve governance of the digital resources produced by CBPP. Selected communities for this study are the IETF (Internet Engineering Task Force), Wikipedia, the free software movement and multi-player game communities. By analysing examples illustrating their governance, we want to see how they can be qualified of CPR and not only as CBPP.

2.1 Clearly defined boundaries (effective exclusion of external un-entitled parties)

Everybody can enjoy the digital resources produced and shared according to commons-based rules. Everybody is authorized to use (appropriate) the resource, and to contribute to its development (ensure the provision). Therefore the definition of the boundary of the community who is able to use the resource could be inclusive, instead of being exclusive. The opposite is the exclusion of people from a normal consumption of the resource, defined as the mere usage, which would be contrary to the social norm. Indeed, the usage of CBPP digital resources is governed by open licenses, which grant to the public the right to access and reuse the resource, which is the online equivalent of the consumption and the production. However, open licenses governing the appropriation of such resources have been designed in order to install a specific type of boundaries around the information resource in order to prevent private appropriation and exclusion. Indeed, users who want to reuse and modify the resource will have to distribute the resulting information under the same licensing conditions, further allowing access and reuse for all, and preventing anyone from privatizing a part of the CBPP. In that sense, the legal infrastructure governing the appropriation of the resources defines clear boundaries. The licence effectively protects the resource from exclusive appropriation so that it remains available for all to use.

Besides, it is difficult to put geographical or technical boundaries or fences to the internet. As it was described above about the IETF, the internet protocols and overall infrastructure are considered as CPR on which every user can build their own service in a decentralized manner, without asking for permission and with limited central control (internet governance is qualified as multi stakeholder). This is possible even though the internet uses privately owned networks because of the “net neutrality principle”, allowing the extension of the network, the transportation of any data and the development of any service without discrimination or control. But this principle is now under pressure from carriers (Schafer, Le Crosnier, 2011). The introduction of boundaries by internet service providers who would favour one service, or by states who would control or filter activities, jeopardizes the internet as a global public good. Building walled gardens online is equivalent to installing frontiers and giving a preference to actors and application and allow excludability and appropriation. Opponents to net neutrality claim it does not allow the internet service providers to exercise their property rights on the service they offer by letting them prioritize traffic and propose differentiated pricing. The market solution is favoured by cable owners who claim that other businesses are free-riding on their investment. We are here in a typical definition of boundaries between the private market for access (carriers collect fees from internet users), and the commons of protocols, transportation and information access.

2.2 Rules regarding the appropriation and provision of common resources that are adapted to local conditions

The second principle looks for congruence between appropriation and provision rules and local conditions. In the case of digital resources which are global in nature, local conditions can be understood as the structure and the features of the resource, its evolution in time, the culture and the custom of the community, the netiquette. The concept of local conditions should be defined in a broader way than the mere geographical boundaries, due to the worldwide nature of the internet and of digital platforms, only limited by language inter-comprehension. The appropriation of the digital resources corresponds to the faculty to access and to reuse works, data, and software. They are in principle in open access: no legal or technical barrier can prevent members of the communities and even outside free riders to read and reproduce creations which are available under an open license.

The provision of the digital resources will correspond to the infrastructure necessary to create and host the work, it can be the server, the website, the platform. Provision rules correspond to the norms governing the access and the usage of the platform, the participation to the creation and maintenance community. Participation is in principle open to all, based on voluntary efforts. There are no local rules governing the provision of digital resources, for instance making it the norm to contribute proportionally to one's consumption.

Statistics show that most free software projects and Wikipedia articles are initiated by one person, created and developed by a core of very few users, while activities of maintenance correcting bugs and editing involve more people. While there are no institutional arrangements per se to request members from a community to contribute, appropriation and provision are open to everybody, and the way to contribute is technically organized in a collaborative way which is taking advantage of the features of the communication and editing tools available. Therefore, it is important to make it easy for newcomers to participate and access to the provision platform, and to find an incentive to participate in the provision and the maintenance. They can be degraded, eroded, destroyed and communities who want to use them have an incentive to protect them. Digital resources cannot be exhausted if overused, but run the risk to be underused if no one curates, develops, edits and update them.

2.3 Collective-choice arrangements that allow most resource appropriators to participate in the decision-making process

In the digital world, appropriation means de facto copying the resource. Any digital commons resource has a lot of users, considering the open access characteristic, some contributors, and a core of building actors. For free software, any user can participate through viral and diffuse activity, like promotion, bug report or sometimes-financial support. But in fact, the real appropriators, in the Elinor Ostrom sense, will be defined as those who loosely or centrally participate to the construction of digital resources. And the way they define the goals and the development process of their specific resource, e.g. the governance, depends on the degree of their investment. Software, for example, is not only a resource, but also a tool to use in other resources. Those who only use the tool are less involved than those whose software depends on the first resource. The "community" in charge of such digital CPR is dynamically defined by

those who want to participate in the construction of the resource, and not only to use it. Open access is a basic right for all users, but participation and decision mainly depends of a core group of appropriators.

The internet is a tool that helps coordination and peer production and the digital world is full of specific arrangements like voting systems, mailing lists or wikis, that those who create and maintain digital CPR can use to participate to the governance of their specific resource. But the internet is also a tool that is plagued with never ending discussion, late night rants and flame wars. Some communities forged the concept of “benevolent dictatorship” to qualify their governance model: everyone can participate to the debate, develop its arguments, and in that sense “most resource appropriators may participate in the decision-making process”, but *in fine* someone has to decide. Linus Torvalds, for example, is not only the creator of the Linux operating system, but he also monitors which software pieces are good and necessary enough to incorporate the core. This is possible because of two characteristics of free software: each piece of software has a “programming interface”, so any developer can create and distribute its own add-on, by this way no one is never excluded of the community (which brings back to 2.1 and 2.2 argumentation about exclusion); and on the other hand, anyone who disagrees can “fork” the development process, which creates another community and take all that was developed before as foundations for a new project. Such forks help free software projects to be perpetuated even when their founders abandoned it. But not too many forks occurs, because there are hidden costs, such as the need to create new community, the debates that follow, the risk that division destroy the project. So the consensus is the new decision-making target: one can fork, so others have to take care of its opinion; but none have interest to fork, so everyone’s interest is finding that consensus. In fact, it is a “diplomatic dictatorship”.

Such a process also occurs when the global community of the internet technicians and engineers have to elaborate protocols and define standards in the IETF community. After one proposes a “Request For Comments”, anybody can participate to the decision-making process, which is open, and validate, refute, or propose technical changes. By the end of the process, either the RFC becomes a standard, or is forgotten, except if the first proposer wants to implement it and sometimes may gain support from other technical users. But, as far as the community has enough time to find consensus, from one hand, and also as the malleability of the digital world authorises experiments on the other, this kind of fork is of very low probability. In fact, if something works well, it may gain the community agreement. “Rough consensus and running code” (Clark, 1992) is the motto of the IETF.

Sometimes observers consider only the altruistic approach of digital resources building. In fact there are also rivalry, conflicts, hegemonic views, as in any human activity. But the way forking and consensus have to walk hand in hand is a basis for the deliberation process. And with internet transparency, debates occur publicly, so even end-user appropriators can forge their own opinion, sometimes diverge with community founders and voice in the process.

2.4 Effective monitoring by monitors who are part of or accountable to the appropriators

Two examples of monitoring are presented, mailing-list moderators, and wiki editing policy. Both are members of the community and subjected to the scrutiny and the control of the peer

producers and to charters or policies governing the nature of content that cannot be included or the kind of behaviour that cannot be accepted in a given community.

At the beginning of the internet, moderators of some discussion lists were an example of monitoring. In such an ecosystem, any subscriber can receive and share information by email from all other participants under the control of a moderator monitoring emails and approving or rejecting them before they were sent to the entire mailing list. With the extension of groups with more members, there was more chance that unwanted emails (mainly spam, administrative demands or private emails going through the list), and flame wars (lack of comprehension between some actors that explode in a great exchange of aggressive mails in a short timeframe) would threaten the whole community. To counter such process, lists often used a moderator in charge of allowing the diffusion of emails to the whole group. Though typically hierarchic, such social structure is a real guarantee against degradation of the collective commons of the list. But such moderator has to refer to the group charter or netiquette. Any personal bias on the list by a moderator certainly means people leaving the group, and if the subject is of importance for them the construction of another networked group. Forking also occurs by members leaving the email discussion for other social media.

Versatility of digital documents helps rapid change, back and forth. But if anyone can change a digital document, some kind of monitoring process is needed to ensure that such a document is not vandalized or privatised. The digital nature of editing platforms has built-in tracking features that allow tracking every action and their authors automatically without a need to monitor actively. For instance, with the wiki edition software, all modifications are visible in the history section of the page, and it is possible to compare versions and to revert to a previous version if a contribution does not match the editorial quality criteria.

Open to everyone to write and modify articles, Wikipedia experiments every day with attempts to add false information or to use the articles as a promotional tool for ideological or commercial purpose. When someone alters an article, those who already participate to the process of editing this page receive the information. And they can act to maintain the global quality of the encyclopedia and avoid degradation. There's also a special "discuss" page attached to each article hosting conversations between contributors about the article explaining changes and where divergent point of view can confront and find consensus, and this in a transparent mode, every simple visitor being able to access this conversation. To help reaching a consensus on the wording of an article, users have to comply with a policy named the "neutrality of point of view" (or NPOV, see Wikipedia policies). Such rules of good practices are essentials for accountability and quality control. An individual moderator cannot delete an article because of its own inclination, it has to resort to the global rule and policies of the community.

2.5 A scale of graduated sanctions for resource appropriators who violate community rules

Protecting a community against anti social activities is a key paradigm for any collective process. But it is not easy to implement online or offline sanctions in the digital world. Mainly, users online communities act under the identity of avatars, may it be their email address used as a login, a pseudonym or an avatar. The main sanction can then be exclusion of the avatar from participation, and sometimes, when frequently received, exclusion through the IP address of such

a user. But the problem with avatars is that the same physical person can have multiple identities on the internet, or can create another email address through free services like Gmail, Yahoo! or Live/Hotmail. This requires an on-going vigilance. To the contrary, good netizens want their online reputation to be high. An antisocial behaviour can plague a user, who lost trust and confidence from others in its own community.

One of the very first debates around sanctions in the digital world, where many believe that free flow of any information and opinion was the ultimate rule, occurred in a multi-users text-only game in the early nineties. In such a game, users exchanged only by writing through their console with a global common platform that help them interact. In one of this game called LambdaMOO, a player offended others by initiating a voodoo doll that could act under the name of other players and this program helped a player nicknamed Mr. Bungle to write sexual descriptions under this umbrella. This was considered as a “rape in cyberspace” (Dibbell, 1993) and led to a debate about sanction within the community. After a two hours and forty minutes online meeting, no conclusion was adopted, showing that if cyberspace is one of the best place to exchange and share ideas, it is not a good decisional area. But one of the Wizards (system administrators) decided to exclude Mr. Bungle. This lead to the constitution of an internal mechanism for any user to ask for sanction, and a system of ballot for decision, which Dibbell calls “turning into a society”.

This experience helps global platforms to design processes to exclude users that want to destroy the collective resource. Graduation of control and sanction are set in the Wikipedia charter, involving for instance blocking users who are abusing user account or disrupting. For example, Wikipedia defines conditions when someone who repeatedly tries to alter in the same way an article can be excluded, even by collecting his IP address, which in real world law is considered as personal information.

2.6 Mechanisms of conflict resolution that are cheap and of easy access

Alternative dispute resolution mechanisms are powerful tool to resolve conflicts and avoid the long and expensive process of going to court. Physical communities may have a mediator, or an elected body able to check the case and propose a solution to the plaintiffs. The question is whether digital communities are reproducing these tools online or maybe creating distinct procedures. Technology offers online dispute resolution mechanism tools (see Musiani, 2009), which can be used to assist negotiation and lower both the cost and entry-barriers.

Wikipedia has developed a dispute resolution process (see Wikipedia Dispute Resolution), but the most sophisticated is the Uniform Domain Names Dispute Resolution Policy (UDRP). It has been developed by the Internet Corporation for Assigned Names and Numbers (ICANN) in order to address the problem of cybersquatting, a practice consisting of registering a domain name in order to try to resell it to the trademark owner at a higher cost, or to take advantage of the reputation of a trademark owner. ICANN can be understood as a “decentralized collective action” (Johnson & al, 2001), the authority of peers governing a common-pool resource, the finite list of possible domain names.

In that sense, this design principle can be applied to internet governance. It is questionable whether similar structured mechanisms are already in place for other, maybe less structured, online communities. Some users have been asking that Creative Commons would put in place an arbitration mechanism, but the organization developing the licences claims to not be a party to these licenses. This could be an activity that could be developed by the peers outside of the system. It would avoid assigning justice and interpretation power to the legislative body who draft the contract.

Before resorting to conflict resolution, conflict can be solved by discussion within the community. Online monitoring reveals the role of the moderation by the community for the discovery of the infringement which could have remained unnoticed by the rights holder whose will is not respected, or by the community in which commons may suffer from vandalism or private appropriation (see section 2.4), but also who can constitute a visible force to denounce the infringement and publicly shame the infringer, which can be more effective than a long procedure in order to force compliance. To enforce the General Public Licence, software developers look at the code of programs. A process asking any secondary creator to guarantee the respect of the licence mainly by sending a request or by putting the violation in a public agora of developers is generally sufficient to ensure respect of the rule.

2.7 Self-determination of the community recognized by higher-level authorities

Open licenses used by the digital CBPP communities are a form of self-determination in the sense that they constitute private regulatory means which have been chosen by the communities as the most effective mean to govern the access and the use of the collectively-produced resource. These contracts are however based on the law of local jurisdictions, hereby considered the higher-level authorities. Self-determined licensing rules are part of a larger legal ecosystem. In order to be recognized as valid and legitimate governance rules, they must be recognized compatible with the applicable law, in a sort of pyramid of normative hierarchy a la Kelsen. If those licenses require legal enforcement beyond the monitoring, public discussion and alternative conflict resolution mechanisms described above, then the contract can rely on enforcement by higher-level authorities, the jurisdiction's court.

The GNU-GPL and the CC licenses have been tested in Germany, the Netherlands, Spain, Belgium, Israel (see CC cases) and successfully applied by the judges in those jurisdictions. Higher-level authorities have recognized the validity of such arrangements, and interpreted correctly features which are constitutive of the self-determination of open communities. The most emblematic governance rules present in the CC licenses are the Attribution, Non Commercial and Share Alike conditions. According to the license, users are entitled to modify works, but by respecting the provider's conditions: specify the name of the authors, ask for a separate license in case of commercial use, apply the same license to the resulting modified work. These cases successfully applied the provisions of the licenses and demonstrated that the conditions are enforceable and find their place within the applicable legal ecosystem.

2.8 In the case of larger common-pool resources, organization in the form of multiple layers of nested enterprises, with small local CPRs at the base level

One may wonder how a global network as the internet can be resilient enough not only to accept billions of new users a year, but also to extend protocols, applications, and services. There is no orchestra leader in the internet model. Each new server or network can add its services and connect its users without asking permission. The internet is not only a “network of networks” for the basic transport and connection functions, but it is also a common conduit for many different protocols. This is called the end-to-end principle (first mentioned in Saltzer & al, 1984, see also van Schewick, 2004), where only server and clients consider their connection and the kind of exchange they want to have. This paves the way for incremental as well as radical innovations.

When a user wants to add a new service to the internet, he needs only to find an audience and build a community. If successful, such a new service is to be incorporated on the global internet and become known by all. The internet can be considered as a lot of interconnected layers (on the layers principle, see Solum & al, 2003), protocols and applications. Each community is responsible for the definition and maintenance of one of these limited parts of the internet (for an early article on decentralized governance, see Post, 1998, on the need to keep the decentralized architecture of the internet in mind when developing governance, see Johnson & al, 2004).

This ability to have incremental changes, linking between chunks of information, and the capacity to integrate outside works into any page (as maps, video, and now what is called “linked data”) are basis for the extension of the world wide web. Each one develops his own site or service, and search engines and the linking process create some kind of glue. This is helped by community definition of standards. Technical standardization bodies allow the industry market players to coordinate and develop control applications for each file format, for instance ebooks or mp3. These integrated platforms, from rendering to control, are submitted to patents, and patent pools (for instance for MPEG, see Guth & al, 2003) try to prevent a tragedy of the anti-commons to regulate the licensing of bricks to develop compatible products and applications.

But it also has a dark side, so-called “browser war”, where main actors of the browser software try to change the global standards to gain commercial advantages or enclose their users inside wall garden services (Le Crosnier, Lecarpentier, 2010). In such a case, any web developer must take care of every browser on the market to create interoperable sites. The same occurs now for mobile access, mainly for video, or with ebooks readers and standardisation of the epub format. The success of the internet relies on nested initiatives, but its force depends of its global interconnection and interoperability, and such commercial practices can quickly become new enclosures without involvement of the community of web developers.

For the layman, the internet is at the same time a network, a pool of protocols (web, mail, instant messenger) and services (websites, e-commerce, video on demand). In their mind, all this occurs over “the internet”, kind of a magical term, and by the time more people use a web browser, it then becomes the ubiquitous tool encapsulating every “access to information”. But for internet producer communities, and for each service builder, the internet is more like a bunch of protocols, languages, services, that they have to compose to realise their own objectives. Each

debate, conflict, and solution occurs at a specific level, but needs a worldwide view of all other nested initiatives to evaluate their consequences on other projects. We encounter again the dilemma between the global access by every user/appropriator, and the active community that mostly represent the producers and the actors of each service.

3. Discussion: how can the Commons approach be applied to global digital resources?

In this article, we tried to match Ostrom's design principles with some typical examples of digital CBPP. We find that we can use those principles to better understand the way internet communities manage digital resources. As they are addressing the governance of the communities, applying such principles helps getting out of the dilemma pertaining to the very nature of digital resources and preventing to consider them as true CPR because of such differences.

First, scarcity does not affect the reproduction of digital resources. Physical resources are rival and excludable and can be exhausted. By design, digital resources can be reproduced ad libitum, allowing some to consider them as public goods rather than CPR. Digital resources present indeed many differences from the physical resources where CPR has been observed. Digital resources in principle do not have the economic features of the CPR, but the market is re-introducing them artificially, leading to their enclosure and to tragedies of the anticommons.

Second, there are differences of community scale and limits, both in space and time. CPR are long-enduring local communities, while CBPP online communities are not localized physically because of the global nature of the internet, as its history is relatively short. But reviewing concrete experiences of production, maintenance and sharing of such digital CBPP resources shows that, like CPR, they are also subject to pollution, degradation and community dysfunction. If no one volunteers to curate the resource and protect it, it won't flourish, being it a natural resource or a digital product.

We also find that digital resources are an enduring process. The internet is evolving permanently with new protocols and applications, and digital resources must adapt accordingly to remain useful and accessible. This requires empowering community members to understand the basic principles of openness and the need to nurture and protect resources from privatization. Net neutrality and the end-to-end principle are such basic concepts that one needs to care and protect for the internet and its digital resources to remain CPR, and for the CBPP to exist in the future. But in this process, that is a very important difference with the localized and small to medium scale CPR communities that pertain to the natural world, which is the main body of the commons research, we need to consider large scale communities, with very loose internal connections except the internet itself. We also are confronting large scale private industries, that commoners need to interact with, the telecommunication operators that manage the physical layer, the search engines and social media platforms that help accessing to information, be it in a market model or defined as CPR and collectively owned as a CBPP.

The impact of the political world, translated by public policy decisions at national or multilateral scale, on the activities of the commoners, the actors of online CBPP communities or digital CPR, needs to be better taken into account. The public domain of resources and usages which are not

governed by the market rules, the need for limitations and exceptions to copyright in order to achieve collective objectives as well as private usages, the protection of net neutrality for all actors through law at the multilateral level, and the expansion of CPR as free software or collective information products, ranging from Wikipedia to Open Access to science primary findings, by promotion in school, university or administration, all are global problems that states and multilateral bodies need to address. The community-only approach, which is at the very heart of the internet founder's ideals (Turner, 2006), is confronting new challenges in this process. A subsidiarity-type of relation needs to be defined between communities and states. Coordinating internal empowerment through sharing and communities self-determination, and social or political position to protect open access and CBPP of digital resources is a key question for the development of digital resources as CPR, and the existence of self-organised communities to produce, maintain and protect them. This further research may help to create bounds with those working on the natural commons dealing with the extension of the concept to global resources and communities (Ostrom & al, 1999), for example climate change or the commons movement's concept of Rights of Mother Earth and other global commons.

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