The Materiality of the Immaterial:

ICTs and the Digital Commons

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Introduction: The Materiality of the Immaterial: ICTs and the Digital Commons

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Abstract: Today, two great signs of change are occurring. On the one hand, the capitalist world economy is putting tremendous pressure on the earth's biosphere and bringing an onslaught of destruction to immediate environments and vulnerable people worldwide. On the other hand, the rise of new and progressive social-economic foundations is the result of an unprecedented increase of information and communication technologies (ICTs). Therefore it is arguably more crucial than ever to understand how social, economic and ecological foundations of the internet and ICT infrastructures are interwoven. What are we—as scholars, activists and citizens—to make of ICTs that seem to emerge from an economic and social system based upon ecological destruction and social oppression, while at the same time engaging millions of people in the proliferation of information, knowledge and active democratic collaboration? This special issue investigates how we can begin to understand this problem, and how we can hope to balance the perils and promises of ICTs in order to make way for a just and sustainable paradigm.

Keywords: Commons based peer production, peer-to-peer, political ecology, ICTs, materiality, immateriality, transition, sustainability, digital commons.

Recent studies by Christian Fuchs have examined the complex web of production relations and the new division of digital labour that makes possible the vast and cheap ICT infrastructure as we know it (Fuchs 2013; 2014). The analysis partly reveals that ICT products and infrastructure embody slave-like conditions that perpetually force mine and assembly workers into positions of dependency. Expanding this argument, the WWF has reported (Reed and Miranda 2007) that mining in the Congo basin poses considerable threats to the local environment in the form of pollution, loss of biodiversity, and an increased presence of business-as-usual made possible by roads and railways. This research highlights that ICTs are inherently material, as opposed to purely cognitive or code based, because the ICT infrastructure under the given economic structure embodies slave-like working conditions, various class relations and undesirable ecological consequences (see also Humphrey 2001). Thus, the position that views the emerging digital economy as purely immaterial is challenged.

At the same time, the emerging digital commons provide a new and promising platform for social developments, arguably enabled by the progressive dynamics of ICT development. These are predominantly manifested within commons-based peer production, i.e., a new mode of collaborative, social production (Benkler 2006); and grassroots desktop manufacturing or community-driven makerspaces, i.e. forms of bottom-up, distributed manufacturing. The most well-known examples of commons-based peer production are the free/open source software projects and the free encyclopaedia Wikipedia. While these novel forms of social organisation are immanent in capitalism, they also present the potential to challenge the dominant capitalist system of production and even transcend it (Kostakis and Bauwens 2014).

However, to view ICTs as being the cause for ecological destruction and social oppression while at the same time perceiving ICTs as a platform for social progression presents a paradox. How can something be at once oppressive and progressive? This question, we

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have discovered, is intimately linked to how ICTs are presented as "immaterial" contra "material" within different scientific discourses. So far, the perception of ICTs as immaterial (e.g. code, software, knowledge) sets one point of departure; whereas the understanding of ICTs as material (e.g. minerals, roads, satellites) sets another point of departure. Acknowledging that these two points of departure from which we understand ICTs are not necessarily distinct from one another, we present this special issue that seeks novel approaches to the concepts of im/materiality in order to dissolve and recreate some core understandings of ICTs and shed light on some of the most animate movements of our time.

Throughout this special issue the reader will encounter a variety of themes and approaches to the presented background. On the whole, we may identify three overarching subthemes.

The first stream of articles contributes to the growing position that peer production is not a form of organisation that is intrinsically beneficial for peers, citizens or users, but a mode of production permeated by political struggle and in need of further research and activism. Vasilis Niaros, in the article *Introducing a Taxonomy of the "Smart City": Towards a Commons-oriented Approach?,* presents this position by using as an example the concept of the "smart city". He concludes that different smart cities will likely create different forms of social and environmental effects depending on different models of technology governance. In a similar vein, J.Z. Garrod in *The Real World of the Decentralized Autonomous Society* argues that some peer-to-peer initiatives, such as Bitcoin 2.0 and its underlying neoliberal vision of freedom, may prove "a far more dystopian development than its supporters comprehend". In line with a similar reasoning, Arwid Lund and Juhana Venäläinen's *Monetary Materialities of Peer-Produced Knowledge: The Case of Wikipedia and Its Tensions with Paid Labour* investigates the internal tensions associated with un/paid editing work in the free encyclopaedia Wikipedia. Here, Lund And Venäläinen raise and discuss important key questions on how Wikipedia as a commons based peer production initiative manifests and responds to ever increasing commercial pressures characteristic of the capitalist economy.

The next two articles focus on the material infrastructure of ICTs. By examining urbanization, ICTs, and the emerging presence of new energy intensive industries in Oregon, Dillon Mahmoudi and Anthony Levenda's *Beyond the Screen: Uneven Geographies, Digital Labour, and the City of Cognitive-Cultural Capitalist* claim that digital labour is something that should be understood as reaching "beyond the screen", or, outside the immaterial, in the recirculation of capital. Similarly, Sibo Chen, in the article *The Materialist Circuits and the Quest for Environmental Justice in ICT's Global Expansion* emphasises the material realities of the ICT infrastructure as both an issue of labour and ecology. He brings perspectives from the field of environmental justice in understanding how global inequalities are in some ways intrinsic to ICTs and consumer electronics in the modern world economy.

Finally, the last two articles deal with issues concerning property regimes. In the article *Commons, Piracy and the Crisis of Property*, James Arvanitakis and Martin Fredriksson ponder whether digital piracy is "merely an act of individual gain or a response to the enclosure of neoliberal private property rights". They state that the act of piracy exposes a weakness in the logic of enclosure; be it piracy in the mundane everyday life of the user, or piracy as an instrument of the revolutionary. Similarly, albeit with a focus on the ascending regime of "open source", Elsa Tsioumani, Mike Muzurakis, Yannis Ieropoulos and Asterios Tsioumanis, in their article *Following the Open Source Trail Outside the Digital World: Open Source Applications in Agricultural Research and Development*, explore whether ICTs can function as a tool for citizens to overcome the intellectual property rights of seeds held by powerful corporations and elaborates on how open source relates to food security.

On the whole, this special issue delivers an array of perspectives, yet commonalities can be found. One such commonality shows that the struggle for a free democratic internet is essentially one and the same as the struggle for labour justice and a healthy biosphere. The political struggle of the user is essentially the same as the political struggle of the farmer; the struggle for the code is the same as the struggle for the seed, and the struggle for digital commons the same as that of the natural commons. In the face of capitalism, the immanent expansion of markets, and increasing alienation, it is time to join causes, or rather, to locate

the underlying common cause in order to progress towards a more mature vision of a future sustainable paradigm.

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Introducing a Taxonomy of the "Smart City": Towards a Commons-Oriented Approach?

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Abstract: The past decade has seen considerable debate over the relatively vague concept of the "smart city". Nowadays, the smart city has crystallised into an image of a city permeated with top-down and centrally controlled technological infrastructures that promise to improve the urban environment in terms of efficiency, security and sustainability. However, many scholars have criticised this perception of networked technologies for not being able to meet the needs of city-dwellers, raising privacy issues, and leading to an increase of environmentally harmful consumption of ICTs. The aim of this article is to contribute to the ongoing dialogue by providing a taxonomy of the smart city, based on certain technology governance models. After theoretically discussing the socio-environmental costs of each model, I argue for a commons-oriented approach, which could democratise the means of making and offer more environmental benefits.

Keywords: Smart city, Technology governance, Commons, Open source, Microfactories

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1. Introduction

The trend towards urbanisation is evident and well-documented. According to the United Nations (2008), the majority of the world's population is now living in urban areas. The fact that most resources are consumed in cities, contributes to their economic importance, but also to their poor environmental performance (Glaeser 2011). By 2050, it is expected that more than two-thirds of the global population will be living in urban environment. This demographic pressure, coupled with global warming and economic instability, has led to a range of new conceptualisations for the city.

Additionally, during the last two decades we have been witnessing a shift towards information- and networked-based socio-economic structures (Castells 2000). As a result, local governments have propagated a persistent interest in the concept of the "smart city". Yet, this concept is nebulous since there is neither a single template of framing it, nor a one-size-fits-all definition (for a discussion on the definitions see Albino, Berardi and Dangelico 2015). The current leading narrative arose from private corporations dealing with advanced information and communication technologies (ICTs) and was later embraced by local governments and advocates of technology solutionism. According to this view, the "smart city" idea has crystallised into an image of a technology-led urban utopia permeated with top-down and centrally controlled technological infrastructures, with the aim to improve the urban environment in terms of efficiency, security and sustainability. In short, common goals for the smart city are better energy and garbage management; reduced water consumption; improvements to citizen mobility; and crime prevention (Albino, Berardi and Dangelico 2015).

However, many scholars have criticised this view of networked technologies claiming that they do not meet the needs and desires of city-dwellers, mainly because they are not attuned to the ways that people use technology (Sassen 2012). Moreover, they raise social issues related to privacy and democracy (Carvalho 2015; Kitchin 2014). As Hollands (2015) argues, the unrestrained deployment of these technologies is shaped around the motives of the sup-

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pliers, i.e. the commodification of their existing products and services. Therefore, environmentally harmful consumption of ICTs increases without serving the true needs of the citizens or even addressing actual problems. Hence, this version of the smart city is seemingly not accomplishing its goals, primarily due to the design and implementation of the technological infrastructure.

It becomes apparent that the adoption of a certain technology governance model will partially determine the formation of the smart city. In other words, the question that arises is who will design, develop and control the technological infrastructure? Are we going to follow a proprietary-based model for designing our cities or should we explore the potential of a more citizen-engaged urban design? As Townsend (2013, 15) asks: "what do you want a smart city to be?".

This article aims to contribute to the ongoing dialogue by theoretically discussing the social and environmental aspects of the smart city and shedding light on an alternative approach, that of commons-oriented technological infrastructures. It is argued that the urban design can no longer be addressed from a singular perspective; hence, a commons-oriented approach should be adopted in order to promote an emerging mode of production. This new mode, named commons-based peer production (Benkler 2006), could arguably democratise the means of making with more environmental benefits. I will tentatively propose the adoption of an alternative technology governance model, which enables the utilisation of existing conditions in the city and sparks the creation of small-scale, bottom-up and need-driven solutions. The latter arguably increases the active participation of citizens in the design and decision-making processes for a sustainable city.

In order to simplify possible outcomes, two axes or polarities are used which are giving rise to four distinct types of the smart city. Section 2 provides a short description of the axes and the emerging quadrants, while section 3 discusses in detail the characteristics of each of the four types. The essay concludes by drawing assumptions about which technology governance model would be ideal for a more democratic and sustainable smart city.

2. Framework

Inspired by Kostakis' and Bauwens' (2014) approach, I adapt their theoretical framework into this analysis as seen in the figure below. Specifically, the first axis concerns the polarity of centralised/global versus distributed/local control of the technological infrastructure, whereas the second axis relates to an orientation towards the accumulation or circulation of capital versus an orientation towards the accumulation or circulation of the commons (figure 1).

The left quadrants include the "corporate smart city" and the "sponsored smart city" where ICT firms and their ambition for profit maximisation are in the forefront. Still, the nature of the implemented technological infrastructures does not follow the same pattern in both types. On the other hand, the "resilient smart city" and the "commons-based smart city" are oriented towards the production of common value with a focus on either local or global scale. The four types of the smart city are described through prominent cases of corporations and collaborative spaces, which produce technologies that exemplify the characteristics of each quadrant. It should be noted that the positioning of the selected cases in the respective quadrants is based on the author's view of their aims and activities.

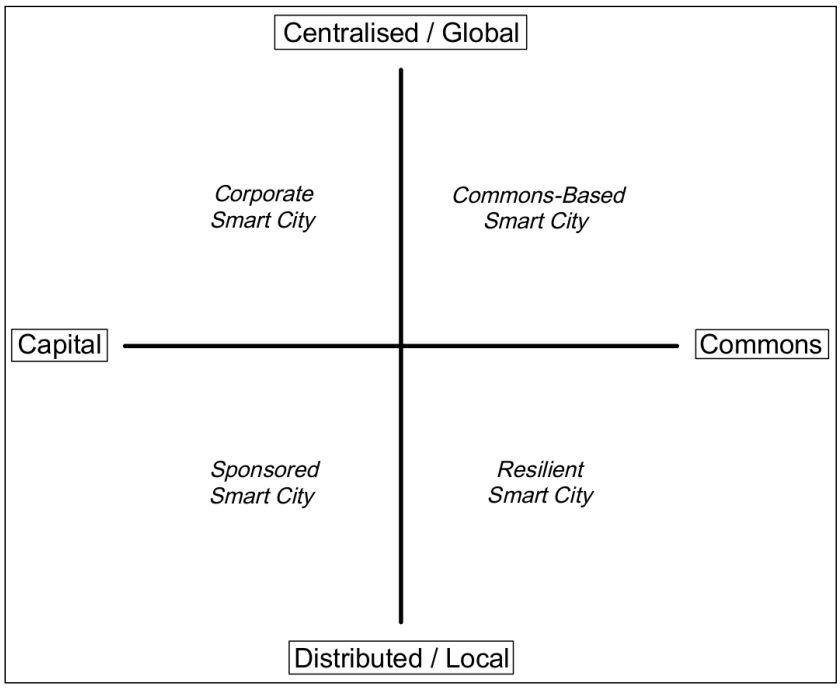

Figure 1: A taxonomy of the smart city

The comparison amongst the technology governance models adopted in each quadrant is defined by the following criteria: i) *citizen participation* during the design and implementation processes of the technological infrastructure; ii) *citizens' privacy*; and iii) *environmental impact* in terms of ICTs consumption.

It should be highlighted that this essay does not aim to offer an all-inclusive account but rather to provide a framework, which could facilitate further discussion around the concept of the smart city. Last, all of the smart city types featured here follow a techno-deterministic approach, overlooking that a non-technical solution could be a better option. However, this does not mean that technological solutions are the only viable way to solve urban problems.

3. Four Types of the Smart City

3.1. The "Corporate Smart City"

The top-left quadrant is related to the leading narrative of the smart city. By employing an often techno-deterministic approach on the uses of ICTs, governments have been looking into how cities might improve urban economies, quality of life and tackle other issues. This has led to a growing role of commercial activities through firms, such as Cisco Systems, IBM and Siemens, which promote themselves as "stakeholders" in public consultation processes (Hollands 2015). As chief executives of Cisco claim, they can provide "intelligent and efficient stewardship of growing cities" (Chambers and Elfrink 2014). These large ICT powerhouses are the major industries involved in the smart city and the Internet of Things (IoT) cluster of technology, having made massive investments. For example, IBM recently announced an investment of US$3 billion over the next four years to establish a new IoT unit (Reuters 2015). Of course, their goal is not just to stumble upon the needs of "actually existing smart cities" but, rather, to create a new market and shape it in certain ways (Shelton, Zook and Wiig 2015).

Popular examples of smart cities are Songdo (South Korea), Masdar (United Arab Emirates) and PlanIT Valley (Portugal). These cities have been built from scratch through public-private partnerships in places with no former residency or infrastructure (Carvalho 2015). Amongst others, IBM and Cisco Systems have been largely involved in these initiatives by providing their products and services. Through the installation of countless wireless sensors

and the utilisation of the IoT at the city-scale, the installed networked technologies are usually targeting real-time traffic solutions, crime prevention, environmental information services etc (Hollands 2015). Such developments aim to transform cities from “dumb” to “smart”. For instance, in Rio de Janeiro (Brazil), the Intelligent Operations Center for Smarter Cities was built in 2010 by IBM for hosting the World Cup 2014 and the Olympic Games 2016. The role of this big control room is to help city leaders gain insight into all aspects of the city and even predict its future performance (IBM 2014). Such optimisation centres have been created elsewhere by many ICT corporations and it is highly expected to see them expanding in the years to come.

Nevertheless, the aforementioned practices have been broadly criticised by many scholars (see Greenfield 2013; Hollands 2015; Kitchin 2014; Townsend 2013; Vanolo 2014). According to Greenfield (2013), even if the involved firms present their initiatives as being city- and citizen-orientated, what they really do is push for the adoption of market-led technological solutions to city administration in order to maximise their profits. Hence, many issues are emerging that affect both the urban environment and the citizens themselves.

To begin with, this techno-deterministic approach cannot arguably meet the true needs of the citizens, since they do not come first. Moreover, corporations propagate rhetoric of the smart city that fosters citizen participation and democratic decision-making. But, as it happens in this quadrant, control and governance in today’s smart city are located within a single proprietary hierarchy, whose main motive is profit maximisation (figure 2). In this case, citizens do not participate neither in the design process of the technological infrastructure nor in its implementation. They are merely treated as another source of information. This is why newly built smart cities such as Songdo and Masdar have evidently failed. Not only are they literally ahistorical but, most importantly, their developers appear to lack any feel for the ways in which cities actually generate value for the people who live in them (Greenfield 2013). It is obvious that smart city vendors like Cisco and Siemens try to redirect the focus of some of their initiatives from being top-down to highlighting inclusivity and citizen empowerment (Greenfield 2013). Through such discursive moves, advocates seek to silence the critics while keeping their central mission of capital accumulation and technocratic governance untouched.

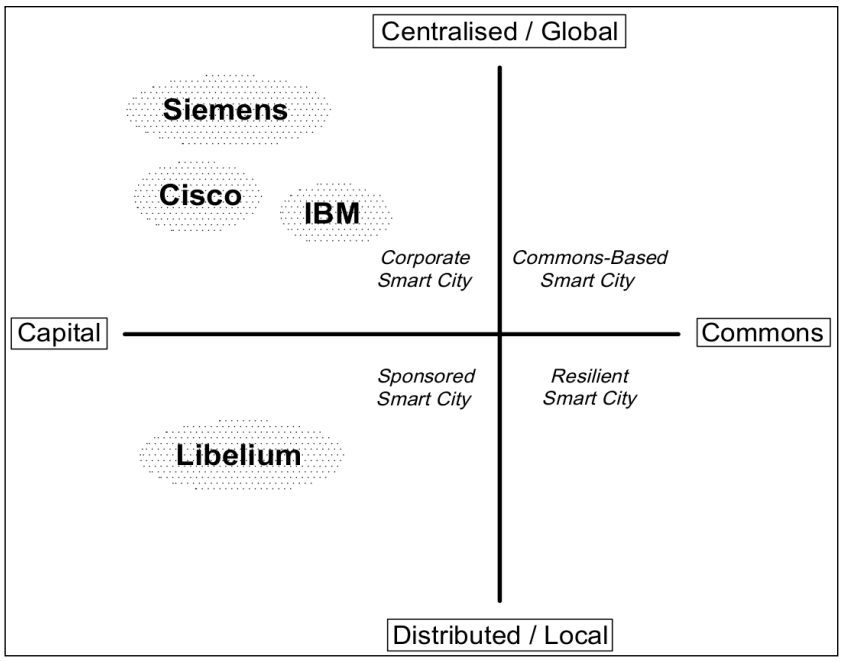

Figure 2: The profit-oriented types of the smart city

Secondly, the installation of thousands of cameras by government and corporate actors and the collection of myriads of data generated by the inhabitants, may have serious conse-

quences with respect to citizens' freedom (Kitchin 2014). The fact that corporations have the control and ownership of the implemented ICTs, transforms the city into a highly privatised space and poses significant threats concerning privacy, surveillance, censorship, and manipulation, that should not be underestimated (Morozov 2013).

Furthermore, the "corporate smart city" does not exhibit only serious social issues. As already mentioned, one of the main reasons for the deployment of ICTs in the city is the reduction of environmental harm. However, as Viitanen and Kingston (2014) argue, the goal here is the expansion of consumerism and not the saving of energy or resources. Since the main motive is profit maximisation, these firms aim to sell as many of their products as possible. Hence, we are witnessing a huge consumption of ICTs with virtually no utilisation of the existing infrastructures. Taking into consideration the underlying material aspects of ICT infrastructures (Fuchs 2013), i.e. slave-like working conditions, class relations and undesirable environmental consequences, it is assumed that the adoption of this technology governance model will not lead to a socially and environmentally sustainable city.

3.2. The "Sponsored Smart City"

The second combination (bottom-left quadrant) matches distributed control of the technological infrastructure with a remaining focus on capital accumulation. Similar to the "corporate smart city", ICT firms are playing a key role here as well. What primarily separates the two types of smart city is the nature of the produced technologies. While in the former type proprietary technologies were in the forefront, in this quadrant the utilised technologies are open source. Yet, there are different kinds of open source projects, which have different goals and requirements. Following West and O'Mahoney (2008), the open source projects are distinguished between "sponsored" (i.e. corporate-led) and "autonomous" (i.e. community-developed). In sponsored projects, one or more corporate entities control the development of the project and employ most of the developers, whereas in community-developed projects, governance and control are shared among the community. What mainly sets apart these two types is their primary goal. On the one hand, corporations aim at maximising their profits from their investment, while an open source community would seek for improvements of the capabilities of the shared technology. Therefore, in this quadrant engages only with the "sponsored" kind of projects.

From corporations' point of view, going open source has a lot of benefits, since it allows them to reduce their development and maintenance cost, and receive greater market recognition (Widenius and Nyman 2013). Companies like Libelium are participating in the formation of the smart city by developing open source technologies. For example, Libelium designs and manufactures hardware and application programming interfaces for wireless sensor networks to establish a platform for the IoT. Recently, they released a new platform for "Precise Urban Monitoring" to enable the creation of future smart city applications and services (Libellium 2015a). But, could the utilisation of corporate-led open source technologies offer more socially acceptable solutions?

Contrary to the conventional technological infrastructures, open source technologies offer a high degree of transparency since the code or the designs of the project are shared through the use of appropriate licenses. However, accessibility to the development process is not assured since the code might not be easily forked. Although companies recognise the importance of attracting participants to the communities built around their projects, most of them provide less accessibility in order to retaining some controlling influence and to ensure that the community will remain aligned with the corporate strategy (West and O'Mahoney 2008). Thus, the distributed control of the technological infrastructures in the "sponsored smart city" entails only the implementation part. In other words, citizens are able to acquire these products and install them wherever they wish, contributing to the generation of local data, but they do not participate in the design process of the technologies, since corporations undertake it. Such practices are opposed to the collaborative way of producing solutions, which allow citizens to discuss common needs, exchange ideas and finally produce better solutions. In its place, Libelium (2015b) has " [...] a sales engineer assigned to you to ensure

you choose the right and optimal configuration to your needs". Nevertheless, even if it is feasible to fork the code of an application or modify a device—which is not the most favourable scenario in the case of corporate-led technologies—great citizen engagement is not granted. In order to adjust an acquired product according to their needs, citizens need certain technological capabilities, which they do not always have. Despite the proclaimed advantages of ICTs use in cities, they can also increase inequalities and promote a digital divide (Norris 2001). Hence, certain factors should be considered when implementing ICTs with regard to inequality and the digital divide.

Similar to the "corporate smart city", privacy issues may also be a central concern. Since the design and the control of the technological infrastructure is in the hands of the "sponsors", it is really up to them to choose the degree of transparency and openness for their technologies. Driven by their motives, corporations will determine who may have access to the generated data and whether it will be freely distributed or not. In addition, anonymity for those using the technologies cannot be guaranteed. What differentiates the "sponsored smart city" from the first quadrant is the fact that, here, users might be able to see what kind of data is gathered and how. Therefore, it becomes easier for them to decide which products they should buy and where to implement them.

Last, although the sustainability of open source technologies might allow for a longer use, corporations may keep producing additional products to make more profit. As a result, a higher consumption of ICTs is possible. Still, in case users are able (both in terms of accessibility and technical capabilities) to fork the code, planned obsolescence will be more difficult to implement. Overall, it seems that environmental sustainability is not entirely linked with this type of the smart city. However, in order to speak more accurately about how these technologies affect the environment, a lifecycle assessment would be needed.

Hence, this approach might be less socially and environmentally harmful than the "corporate smart city", but there are drawbacks in exclusively adopting the technology governance model of the "sponsored smart city".

3.3. The "Resilient Smart City"

So far two types of the smart city have been described whose driving force is profit. The "resilient smart city" (bottom-right quadrant) follows a different philosophy which, instead of encouraging the use of top-down, proprietary technology, is focusing on enabling and empowering citizens for the creation of common value (figure 3). This bottom-up approach aspires to foster new forms of participatory planning and governance, where social and cultural factors are of significant importance. Contrary to the "sponsored smart city", the two right quadrants are associated with the philosophical views of the "free software" movement, which are quite different from those of "open source". As seen in section 3.2, many corporations have adopted the open source rhetoric ("sponsored" projects) due to highly practical reasons, like, for instance, it is producing affordable, powerful and reliable technology (Stallman 2015). On the other hand, the philosophy of the "autonomous" (i.e. community-developed) projects is resembling the "free software" movement, which highlights the meaning of the word "free" and respects the users' essential freedoms to run, study, change and redistribute the developed project. These freedoms are vitally important for society as a whole because they promote social solidarity, i.e. sharing and cooperation (Stallman 2015).

Through the intersection of digital technologies with urban life, several initiatives have emerged that overcome the need for firms or governments to provide solutions and are building their own. Such solutions are now being developed at co-working places, universally labelled as microfactories—alternatively they may be called makerspaces, hackerspaces, fablabs or media labs. In general, microfactories are defined as community-led spaces where individuals meet on a regular basis to engage collaboratively in the creation of meaningful, creative projects (Kostakis, Niaros and Giotitsas 2014). Activists, hackers, researchers and others may have access to prototyping tools there, allowing them to explore and produce small-scale solutions for problems of daily life. Hence, cities of this type are becoming laboratories where common value is produced and problems are addressed by citizens who en-

gage in the research, design and testing of solutions (Hardt and Negri 2011; Hemment and Townsend 2013).

An indicative example of such places is the Metalab, which is a non-profit innovation centre based in Vienna. Like all hackerspaces, it offers a physical space for free exchange of information and collaboration between technology enthusiasts, hobbyists and hackers. Amongst others, Metalab's fields of interest include hardware hacking, free public networks and urban hacking/street art. Another initiative that could be linked with the "resilient smart city" is the Medialab-Prado. This collective innovation laboratory has been established by the Madrid city council and is mainly interested in the production, research and dissemination of cultural projects. Through the development of various collaborative projects and events, the Medialab-Prado focuses at sustaining an active community of engaged citizens.

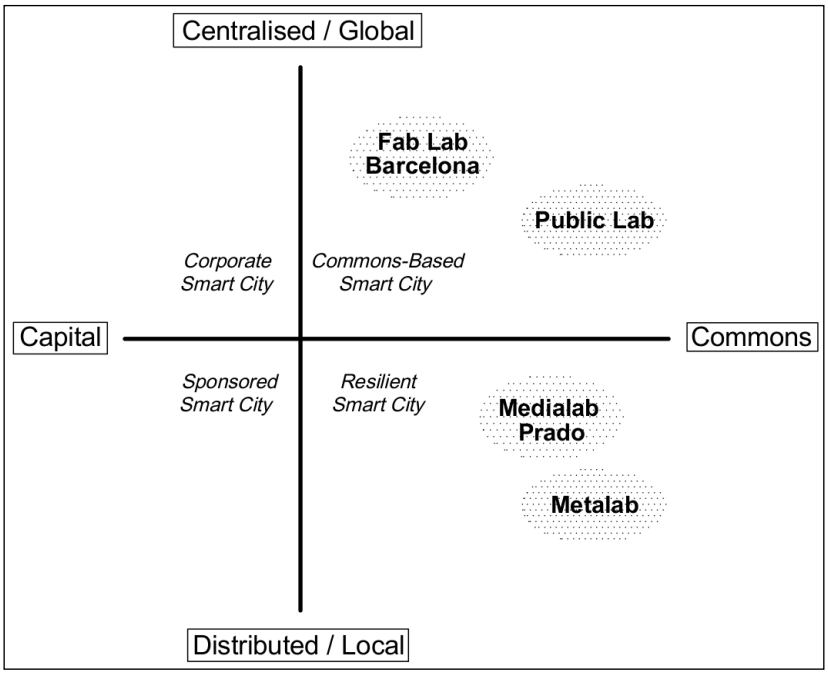

Figure 3: The commons-oriented types of the smart city

The technological infrastructures developed in the aforementioned initiatives have certain characteristics that appear to render this type more efficient than the previous ones. To begin with, they are impregnated with the Do-It-Yourself (DIY) culture which empowers non-experts to become the designers of their own technologies (Antoniadis and Apostol 2014). The threshold for participation in the design process of the technologies is as low as possible, thus we meet higher levels of social inclusiveness. Nevertheless, there are challenges related to digital divides which do not seem to be properly tackled but could be partially addressed through the technical support from the community. Moreover, the fact that citizens have a say during the design and implementation of the technological infrastructures means that almost all of the produced solutions meet existing needs. Hence, this approach is opposed to the supply-driven production system manifested in the previous types and effectively establishes a demand-driven one.

Contrary to the proprietary technologies which come with risks to users' privacy, DIY infrastructures offer a wide range of services that can be operated outside the public Internet (Antoniadis and Apostol 2014). Additionally, since the community has the ownership and the control of the infrastructure, users are able to interact privately within a local network and avoid sharing details beyond it. Also, they have the option of anonymity and can secure their private location information, such as GPS coordinates (Antoniadis and Apostol 2014).

Concerning the environmental impact, the "resilient smart city" demonstrates some more advantages. Firstly, the technologies produced in this type of smart city are designed for a

long-term usage. Thus, less consumption of ICT will take place, compared to the left quadrants. Moreover, the modularity of these technologies allows for a better match between citizen's needs and produced solutions. Even if a technological solution fails to tackle a certain problem, the community's ability to adjust it might reverse the situation. Hence, there may be no need to develop new solutions from scratch and consume more materials.

Last, a fundamental characteristic of the "resilient smart city" is the rejection of the value of bigness and an opposition to the organisational tendency toward large scale. Although relations of collaboration and solidarity may well extend to the global level, the solutions are designed in a smaller scale. This includes strong pre-defined goals that can be bound with measurable results, reduced costs but also quick decision-making. On the other hand, it could be claimed that this locally-oriented approach is not utilising the existent dynamics. The knowledge produced in this case may not be widely applicable or even available for adoption elsewhere. Consequently, the scalability of produced solutions is under threat, potentially hindering the circulation of common knowledge and the subsequent diffusion of innovation.

3.4. The "Commons-Based Smart City"

The last quadrant (top-right) includes a type of the smart city, which currently is far from being mature. It exists only in a seed form but, hypothetically, could offer a sustainable alternative for the evolution of the smart city. The manifestation of the smart city in this quadrant draws the attention towards the global commons (figure 3). Advocates and builders of this approach argue that the commons should be created and fought for on a transnational global scale (Kostakis et al. 2015). The "commons-based smart city" is characterised by wide citizen engagement, while designing and implementing the technological infrastructures, and an ongoing circulation of the commons, which promotes continuous innovation and knowledge diffusion on a global scale.

As already mentioned at the "corporate smart city" (section 3.1), there is a tendency to group smart city discourses into an all-inclusive narrative and use certain examples as indicative of all cities. Unquestionably, cities share some characteristics, but they also have distinct cultures, histories and political economies that shape the urban environment and the relational dynamics. Hence, it can be argued that a globally-organised system for urban development might not be sustainable.

On the other hand, there are numerous small-scale urban commons projects emerging which might be applicable to other cities as well. Consequently, a logical next step would be to communicate the scattered knowledge produced at the local level. One way to do this is through microfactories. Such spaces are considered as essentially networked and might catalyse the up-scaling of the produced commons, not only within the city of origin but universally as well.

An initiative working towards that direction is the Public Laboratory for Open Technology and Science (Public Lab). The Public Lab is a worldwide community of local activists, educators and researchers, which develops and applies open source hardware and software tools to environmental exploration and investigation. Their goal is to grow a collaborative network which will support and enable citizens to discover, contribute and collaborate on locally important matters. Another initiative, which shares the global-orientation is the Fab Lab Barcelona. As a core member of the international fab lab network (Fab Foundation), it aims at creating opportunities to improve lives and livelihoods around the world, by providing citizens with access to the necessary tools and knowledge. Currently, the Fab Lab Barcelona is developing projects in different scales, from smart devices for data collection by individuals (Smart Citizen), to conceptualising new models for cities (Fab City).

However, there are constraints that lead us to the assumption that microfactories alone cannot accomplish the aforementioned goal. First of all, while an increasing number of people are getting involved with microfactories, there is a large part of the population who do not. Yet cities cannot afford to neglect them, since through the collaboration with commons-oriented communities, every citizen could bring to the front an interesting idea and succeed in implementing it (Kostakis, Fountouklis and Drechsler 2013). In addition, as Harvey (2012)

argues, in order to address large-scale problems, such as the global warming, more "centralised" forms of organisation are needed.

It becomes evident that, in order to succeed at scale, grassroots innovation needs support from the appropriate institutions (Kostakis, Bauwens and Niaros 2015). Therefore, this type suggests that smart cities should follow a more synthetic approach which combines: i) the bottom-up innovation through which citizens seek to create a better life for themselves and their community and ii) the top-down policies and planning that seek to distribute resources fairly so that everyone has the opportunity to innovate successfully. This notion has also been articulated by Campbell (2009), an urbanist whose "Massive/Small" concept and theory of "Smart Urbanism" are based on the belief that cities need to harness the collective power of small-scale innovation to make a big difference.

In a nutshell, the adoption of the "commons-based smart city" might encompass all the advantages of the third quadrant infused with characteristics like interoperability and scalability. This could present a more viable alternative for a smart city which takes advantage of the global knowledge commons and utilises them on the local level. Of course, it is not claimed that all cities should apply the same technological solutions and disregard their peculiarities. Instead, they could follow a demand-driven approach and leverage the part of knowledge that suits best to their needs. In addition, collaborating and sharing knowledge on a global basis may inspire the communities to create new tools and solutions related to their local environments and, thus, enrich the global commons.

In order to enhance the functionality of this model, the creation of a unique culture is vital. This may be accomplished through supporting small-scale innovation, which can serve as an awakener for the local community and lead to the creation of a robust paradigm whose core value is collaboration. Towards that direction, governments and local authorities should provide appropriate facilities to enable the deployment of participative ways of working, which will help in producing social innovation outcomes. This could be done by promoting the establishment of collaboration spaces, such as microfactories, in the city and enhance the digital connectivity amongst citizens. Furthermore, governments should focus on establishing legal frameworks that offer the best opportunities to develop local sustainable solutions (for a discussion on the relationship between law and technology see Drechsler and Kostakis 2015). After ensuring the existence of the basic infrastructures, the next step would be to integrate them into every day social interaction and make all data available to citizens. This could be achieved by building digital platforms to promote open governance through the collaboration between local governments and city-dwellers. Moreover, in order for locally-produced innovations to be diffused and adopted globally, the infrastructure should comply with standards that would be designed to enhance interoperability. These standards should shape technologies that are easily accessible, transparent and open to adaptation to local conditions. At the same time, local authorities could contribute to the adoption of open standards through planning frameworks and procurement practices.

4. Conclusions

This essay argues that the formation of the smart city is partially determined by the model of technology governance they embody. The four types differ in their vision for the prime focus, either for the profit maximisation or the production of common value, and the nature of the produced technologies.

It can be articulated that without the adoption of open ICT infrastructures and platforms (i.e. free/open source software and hardware), the construction of a truly smart city will be highly unlikely. Thus, I support a commons-oriented smart city that will provide the capacity for open participation and democratic problem-solving procedures. Citizen engagement in the decision-making processes is essential to create a direct link between technology and the needs of city-dwellers. Participatory urban technologies, greater social inclusion, and a substantial shift in power from corporations to ordinary people and their communities, are crucial elements of a socially sustainable city.

Further, this essay suggests that a commons-oriented smart city exhibits less privacy is-

sues than a corporate one, due to the citizens' motives and the openness of the deployed technologies. Nevertheless, it would be risky to make any assumptions about how scale relates to this matter. Although many researchers and activists have the tendency to presuppose that local equates with 'good' and it is preferred over non-local scales, Purcell (2006) claims that we cannot assume a priori that locally controlled structures are inherently more democratic than global ones or vice versa.

From an environmental perspective, this work argues that the demand-driven production system established in the commons-oriented smart city may offer more benefits. In fact, the reduced consumption of ICTs and the utilisation of the existing conditions in the city allow for more sustainable outcomes.

Last, it is worth noting that there is a lack of in-depth empirical research on a range of smart city developments. Until recently, there have been relatively few extensive case studies on smart cities. Most of the academic work either provides short overviews and critiques on the smart city concept or follows a more technical perspective and introduces new technologies. Thus, further investigation could focus on the empirical study of smart cities and, possibly, compare the propagandised smart city with the actual one.

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The Real World of the Decentralized Autonomous Society

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Abstract: Many commentators have been quick to note the revolutionary potential of Bitcoin 2.0 technology, with some even believing that it represents the coming of a decentralized autonomous society in which humans are freed from centralized forms of power and control. Influenced by neoliberal theory, these individuals are implicitly working on the assumption that 'freedom' means freedom from the state. This neglects that the state can also provide freedom from the vagaries of the market by protecting certain things from commodification. Through an analysis of (1) class and the role of the state; (2) the concentration and centralization of capital; and (3) automation, I argue that the vision of freedom that underpins Bitcoin 2.0 tech is one that neglects the power that capital holds over us. In neglecting this power, I claim that this technology might be far more dystopian than we comprehend, making possible societies that are commodities all the way down.

Keywords: Bitcoin, Blockchain, Ethereum, Capitalism, State

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> "But where change exists, so too do possibilities"— Murray Bookchin (2015, 54).

Although it is still in its early stages, many commentators have been quick to note the revolutionary potential of the second wave of blockchain innovation. Bitcoin 2.0 technology, as it has come to be called by many, refers to the combination of the blockchain (which is a type of distributed database made popular by Bitcoin) with user-programmable smart contracts. By combining the blockchain with smart contracts, the technology can theoretically be used to create any number of social contracts, such as: nongeographic countries (complete with taxes, benefits, and voting), transnational lending programs, universal basic income schemes, marriage contracts—the works (Meltzer 2014; Schneider 2015; Volpicelli 2015). In fact, IBM and Samsung have already used this technology to create a washing machine that orders its own detergent, a proof of concept for the coming "Internet of Things" (Higgins 2015).

For many, however, the most interesting aspect of this technology is the ability to create decentralized autonomous organizations (DAOs), which are essentially corporations in which the management function is automated by code, and the human element is removed (Buterin 2014). While some have expressed fear that the widespread application of DAOs might engender the rise of a Terminator-style Skynet (De Filippi 2014a), many believe that it represents the coming of a "decentralized autonomous society" (DAS) in which humans are 'freed' from centralized institutions of power and control (Alchemi 2015; Frank 2015; Patron 2014; Robinson 2015; Thorp 2015).

Outside of concerns over legality and regulation (De Filippi 2014b; De Filippi and Belli 2012), however, there has been little investigation as to how the DAS might function in the real world. While there are many grand claims, there seems to be little understanding of the wider social context in which the DAS is embedded. Indeed, for all the fear of these technologies, there is little work problematizing their relationship to capitalism, and whether they might in fact help strengthen capital's control over the social world—and, perhaps, by proxy, transform the very institutions of power and control that support capitalist social relations.

Consequently, what I would like to do in this paper is to explore the real world of the DAS, to explore the ideas and theories about social life that underpin these technologies, and

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some of the real world issues that might problematize this utopian vision. The impetus for this project stems from two Massey Lectures*: The Real World of Democracy*, by C.B. Macpherson, and *The Real World of Technology*, by Ursula M. Franklin.[1] In the former, Macpherson (1965, 4) explores the rival ideas of democracy (communist, Third World, Western-liberal variants) and their impacts on one another. Years later, Franklin (1999, 2) proposed a similar strategy, but in respect to technology. Her reasoning was that technology, like democracy, includes ideas and practices; it includes myths and various models of reality. And like democracy, technology changes the social and individual relationships between us. It has forced us to examine and redefine our notions of power and accountability. Against the idea that technology is apolitical, Franklin argued that it was something that has a considerable impact on issues of justice, fairness, and equality. In combining these two approaches, what I want to get across is that is important to compare what is said about something, and how that something might work in the real world; more often than not, the two are incompatible. And in the case of the DAS, I believe there are very significant contradictions between what is said about this type of society, and the model of reality that underpins it.

In what follows, I argue that by adhering to a neoliberal subjectivity, some supporters of the DAS have an obscured vision of: (1) class and the role of the state; (2) the concentration and centralization of capital; and (3) the role of automation. As I hope to make clear, the vision of freedom that seems to underpin Bitcoin 2.0 tech is one that neglects very significant forms of power and coercion; in particular, the power that capital holds over us in both organizing the structure of our lives, and informing our idea of what it means to be human. In neglecting these other forms of power, I claim that the DAS might be a far more dystopian development than its supporters comprehend, making possible societies that are, as Fraser (2014, 5) calls them, "commodities all the way down."

Admittedly, my comments and reflections are anticipatory, as little of what is discussed has come to pass, nor is it likely to come to pass in exactly the way in which I've presented it. There are real issues of scalability, infrastructure, and regulation that must first be overcome before Bitcoin 2.0 tech can be widely adopted in the manner that DAS proponents suggest (Higgins 2015; Scott 2014). As de Sousa Santos (2004, 241) notes, however, a sociology of emergences is one that inquires "into the alternatives that are contained in the horizon of concrete possibilities." By taking account of the "knowledge, practices and agents" (Ibid) involved in the development of new technologies, it becomes possible to "identify therein the tendencies of the future (the Not Yet) upon which it is possible to intervene so as to maximize the probability of hope vis-à-vis the probability of frustration" (Ibid). Consider this, then, my normative strategic intervention into the development of new types of societies. By offering some suggestions as to how we might better use these technologies to secure and mediate the commons (both digital and material), I conclude by arguing that there exists the possibility to create a more sustainable—and possible—future for all.

1. Bitcoin and Bitcoin 2.0 Technologies

While the future of Bitcoin is still uncertain, it is important to briefly overview its origins so as to put these new developments into context. Despite multiple attempts to create digital money, developers had never been able to get around the double spending problem. Because digital money is just information, the same token could feasibly be duplicated and spent more than once. Attempts to solve this problem in the digital world inevitably came up with the same means of solving it in the real world: a centralized authority (such as a bank) that can verify whether or not a token has been spent—i.e. a centralized form of *trust*. This not only created a significant weakness in the system as a result of having a single breaking point, but it also relied on exactly what developers had been trying to move away from.

Enter Satoshi Nakomato. In the aftermath of the 2008 financial crisis, Nakamoto—a mysterious figure known only by his presumed pseudonym—solved this problem. In "Bitcoin: A Peer-to-Peer Electronic Cash System," Nakamoto (2008) not only revealed Bitcoin, but also

[1] In Canada, the Massey Lectures are an annual five-part series of lectures given by a notable scholar.

its central innovation: the blockchain.[2] The blockchain is a public ledger of transactions that can be broadcast to the entire network and subsequently verified by a network of decentralized computers running Bitcoin software. This not only solved the double spender problem, but also provided the framework for other software programs that wished to move away from institutions of centralized trust.

In 2009, the Bitcoin network went live with the launch of the first open source Bitcoin client, and the release of the first bitcoins.[3] Since then, Bitcoin has had a tumultuous journey that has included incredible volatility, market crashes, and government seizures (Vigna and Casey 2015). Although the currency continues to be used primarily for niche purposes (e.g., speculation and black market exchange) it has created a wider awareness of the potential of digital currencies. For instance, Ben Bernanke (as cited in Perlberg 2013, par. 3), the former Chairman of the Federal Reserve, has written that such currencies "may hold long-term promise, particularly if the innovations promote a faster, more secure and more efficient payment system." More recently, the Bank of Canada has said that it may look into issuing its own digital currency, and the Greek government has also suggested this strategy as one means of escaping from the current eurocrisis (Kang 2014; Mason 2015). While some institutions, such as the People's Bank of China, have banned their banks from handling bitcoins, the likely trajectory is the emergence of a "specific licensing category for bitcoin businesses" (Buterin, as cited in Osborne 2014). What is clear, however, is that what began as an experiment is now a part of the global public consciousness—helped, of course, by a market capitalization of billions of dollars.[4]

Despite Bitcoin's popularity, the blockchain remains the central innovation. And from this innovation there have been a number of subsequent developments. Often referred to as the second wave of blockchain innovation—or simply, Bitcoin 2.0 technologies—these new technologies have attempted to extend the functionality of the blockchain by combining it with smart contracts. Created by Nick Szabo (1997, par. 2), smart contracts are essentially digital contracts that are enforced automatically by a set of computer protocols. The simplest example is that of a vending machine:

> the machine takes in coins, and via a simple mechanism, which makes a freshman computer science problem in design with finite automata, dispense change and product according to the displayed price. The vending machine is a contract with bearer: anybody with coins can participate in an exchange with the vendor. The lockbox and other security mechanisms protect the stored coins and contents from attackers, sufficiently to allow profitable deployment of vending machines in a wide variety of areas.

In many ways, Bitcoin 2.0 tech is simply a digital version of this same phenomenon. Sitting on top of the blockchain, the software ensures that the transaction is fulfilled (whatever it may be), and engages the appropriate response (see below for examples). While multiple projects have attempted (or are attempting) some variant of this combination (e.g. Mastercoin, Counterparty, Maidsafe, Storj, Supernet, Gems, Eris Industries and SWARM), Ethereum has received the most attention. Developed by Vitalik Buterin, what distinguishes Ethereum from other Bitcoin 2.0 tech is that it "is an open source platform for smart contracts built on top of block chain technology" (Kosner, 2014, para. 5). Rather than adding new features to the block chain, Ethereum simply allows users to code their own decentralized applications (or Dapps).

By enabling users to program their own Dapps, Ethereum intends to "decentralize control of the Internet and anything connected to it, redistributing real-world power accordingly" (Frank 2015, 26). Encompassing a number of diverse applications such as finance (banking, payments, crowdfunding), sharing economies (Uber and AirBnB-like platforms), communications (social networks, email), reputation systems (credit rating, seller ratings), governance,

[2] This paper is often referred to as the Bitcoin white paper.
[3] Following standard practice, the capitalized version of Bitcoin refers to the technology, whereas the lower-case version of bitcoin refers to the currency.
[4] According to coinmarketcap.com at the time of writing, the market capitalization for bitcoin was $3,295,647,158.

and possibly more, Ethereum could have a massive impact on the future of economic development, and the shape of the global economy. Indeed, as De Filippi and Mauro (2014, par. 19) note, Ethereum is to the political system what Bitcoin is to the financial system: "if Bitcoin was designed as a decentralized alternative to counteract corruption and inefficiency of the monetary system, Ethereum constitutes a decentralized alternative to the notion of the *organization* per se."

Although it is still early days for Ethereum, things seem promising. In 2014, Buterin not only received a $100,000 fellowship from PayPal co-founder and venture capitalist Peter Theil, but also won the World Technology Network award, beating out the likes of Mark Zuckerberg (creator of Facebook) in the IT software category (Hajdarbegovic 2014). More importantly, perhaps, is that IBM and Samsung chose Ethereum as one of three protocols for their proof of concept for ADEPT (Autonomous Decentralized Peer-to-Peer Telemetry), or an 'Internet of Things' powered by the blockchain.[5] In their draft paper, they demonstrate how "a humble washer can become a semi-autonomous device capable of managing its own consumables supply, performing self-service and maintenance, and even negotiating with other peer devices both in the home and outside to optimize its environment" (as cited in Higgins 2015, par. 9).

2. The Decentralized Autonomous Society

While the prospect of a washing machine that can order its own detergent is intriguing, the true draw of Ethereum is its potential to remake the social world. The central institution that makes this possible is the decentralized autonomous organization, or DAO. As the name suggests, DAOs are essentially digital organizations that manage themselves: "long-term smart contracts that contain the assets and encode the bylaws of an entire organization" (Buterin 2014, par. 2). Depending on how they are structured, certain members of the DAO might be able to spend its funds, or modify its code.[6]

Buterin (2013, par. 2) has described DAOs as an attempt to extend the logic of the industrial revolution upwards. Where that revolution allowed us to "start replacing human labour with machines," it only automated the bottom half of the equation, "removing the need for rank and file manual labourers." DAOs are thus an attempt to see if it is possible to "remove management from the equation, instead." With such technology, it becomes possible for self-driving cars to autonomously make micro-payments to each other for the right-of-way, or to share data plans via mesh networks, making much of the internet infrastructure unnecessary (Pollen 2013).[7]

[5] BitTorrent was chosen for file sharing, Ethereum for smart contracts, and TeleHash for peer-to-peer messaging.

[6] The methods by which funds are allocated, explains Buterin (2014, under "Decentralized Autonomous Organizations"), "could range from bounties, salaries to even more exotic mechanisms such as an internal currency." While this vision is one in which the DAO is essentially a digital replication of the corporation (with dividend-receiving shareholders and tradeable shares), Buterin (2014, under "Decentralized Autonomous Organizations") notes that there exists the possibility for alternative models, such as one in which "all members have an equal share in the decision making and require 67% of existing members to agree to add or remove a member."

[7] Buterin (2015) gave a more in-depth view at this future in a talk given at the Swiss Institute of New York: "You wake up, and see that $17.27 was automatically deducted from your primary wallet, as you had authorized to happen every day, to pay the rent for your apartment; if you canceled the authorization, then, after a warning period, ownership in the land-registry contract would automatically transfer back to the landlord, and the door lock would no longer recognize signatures signed by your smartphone's private key as valid for letting you in. Of course, your landlord is bound by the same restrictions. If he shuts off his account that pays the local government $6.60 land-value tax per day, then he loses ownership and the contract automatically switches over so you are renting from the government instead. The government itself is simply a large decentralized organization, and you can see in real time the $6.60 moving on the blockchain and eventually getting into an account to pay for a medical-research program trying to extend the human lifespan from 170 years to 230. The Internet that you are using to access this information is based on a decentralized and incentivized mesh-networking platform; you paid $0.0009 to access the information, but your laptop also earned $0.0014 transmitting other people's packets at the same time. You get into your Mastercar self-driving car to go to work (originally, all self-driving cars were made by Google, but Master Corporation, a decentralized autonomous entity that automatically uses a combination of futarchy and liquid democracy to determine how the company should spend its funds each day, proved that its governance mechanism was so efficient that it overtook Google on some core services within three years, and alt-Mastercorps took over most of its other operations). You get in, and Mastercar runs a optimized version of the A*

For many true believers, however, smart contracts, blockchains, and the DAOs that might stem from them, are the building blocks of something much bigger: the decentralized autonomous society (DAS). While there are competing versions of this possible future, the predominant theme is a society in which technological development has disrupted the centralized and hierarchal forms of the nation-state system.[8] In this society math, perfect information, and market mechanisms are supposedly able to solve the problem of organizational politics by removing humans from politics altogether.

Viewed as inherently corruptible creatures, the thinking goes that it is far more sensible "to base a future economy on the mathematical laws of the universe, outside the grasp of human error and manipulation" (Patron 2014, 102).[9] Through DAOs, it is claimed, we might be able to augment human autonomy by automating the governance of all organizations, since DAOs can run "without any human involvement under the control of an incorruptible set of business rules" (Larimer 2013, par. 2). And since the code simply runs itself, these DAOs could run forever, making politics a simple problem of engineering.

Inherent in this view is the idea that political elites have too much power, and are a hamper on freedom. Billionaire Peter Thiel, for instance, writes that he no longer believes "that freedom and democracy are compatible" (as cited in Frank 2015, 27). Perhaps it could exist, "he imagined, in cyberspace, in outerspace, or on high-seas homesteads, where individualists could escape the 'terrible arc of the political.'" Similar remarks have been made by Roger Ver, the prominent Bitcoin investor, who argues that such technologies "will prevent governments from being able to just print money at will and then use that to buy tanks and guns and bombs to murder people around the world" (as cited in Dodd 2015, par. 4). While not all cryptographers share these views, Karlstrøm (2014, 29) notes that there has always been "a strong current of libertarian sentiments in the discussions about cryptography." Indeed, the popular economist Paul Krugman (2014, par. 1) has confessed that his own uneasiness with Bitcoin stems from the fact that it is "intimately tied up with libertarian anti-government fantasies."

Many, however, claim that these anti-government fantasies are unrealistic. More likely, claims Kosner (2014), is that DAOs intermingle with other, more traditional, centralized organizations, with each focusing on what it scales best to (Kosner, 2014). This point is echoed by De Filippi and Mauro (2014, par. 22) who suggest that it is more plausible to see a future in which "decentralized organizations with distributed models of governance, independent legal systems, or perhaps even autonomously governed communities . . . compete with both governments and corporations."

Such points seem to insinuate that we do not need to fear the libertarian fantasies wrapped up with Bitcoin 2.0 tech. Indeed, Buterin (2014) himself even titled one of his blog posts, "DAOs are not scary." This does little to alleviate my fears, however. While I agree that

search algorithm (for which James Wilbur automatically got a bounty of $782,228 worth of MSC from the Master Contract) to determine the optimal path to your primary workplace. Given that your self-tracking app has detected that you value your own time (or, rather, the delta between time spent in a car versus time spent at home or work) at an average of $14.18 per hour, the Mastercar's algorithm chooses a route that takes an extra eleven minutes in order to avoid road tolls and also on the way moves a shipment from one side of the city to the other. You drive out, and thirty minutes later you have spent $1.04 on electricity for your car, $1.39 on road tolls, but receive a reward of $2.60 for moving the shipment over. You arrive at work—a location which is a hybrid living/working space where 'employees' of five different alt-versions of Master Corporation are spending most of their time, except that you chose to live at home because you have a family. You then get to work, running simulations of a proposed new scalability algorithm for the now community/DAO-driven Ethereum 6.0."

[8] Perhaps channeling Castells (2010), "The Fundamental Thesis Of The Network Society" provides one example: "1. Widespread social and economic change only happens once a solid technological foundation evolves to make it sustainable. 2. Globally distributed and decentralized technologies have emerged that achieve superior results with respect to centralized and hierarchal ones. 3. These unstoppable technologies undermine and disrupt the Nation State's supporting pillars. The resulting socioeconomic organization is the Network Society."

[9] In talking about Ethereum, Buterin tells Frank (2015, 36) that it is rather naïve to trust "corruptible humans and opaque institutions with concentrated power. Better to formalize our values forthrightly in code." Similarly, a firm named Colony (2015) that is in the process of creating a DAO interface (where DAOs are referred to as colonies) states: "Colonies are kind of like companies, except instead of being managed by fallible individuals, Colony harnesses the wisdom of the crowd using AI to make sure that the right things get done by the right people, at the right time."

it is unlikely that DAOs will immediately overtake our existing forms of social organization, I am more concerned with the way in which these technologies reflect the contemporary thinking about the self and the wider society in which that self is constructed. For instance, the idea that politics is a simple problem of engineering is one that is underpinned by an image of the human as inherently selfish, greedy, and ultimately, corruptible. DAS supporters are thus beginning "from the assumption that there is no trust and no community, only individual economic agents acting in self-interest" (O'Dwyer, 2015, par. 15).

As many scholars have demonstrated, however, this image of the individual is as much a social construct as the traits that are ascribed to it (Burkitt, 2008; Elias, 2000; Macpherson, 2010; Teeple, 2004). Indeed, as Durkheim (1973, 80) notes, in earlier societies "so small a place is given to individual personality […] not because it has been restrained or artificially suppressed," but "because, at that moment of history, *it did not exist.*" While modern forms of individuality started to emerge from the 14th century onwards, it is incredibly important to hammer home the point that there is no essential human nature, and that pre-modern peoples "thought of themselves as, not individuals but members of ranks or orders or communities" (Macpherson, 1965, 7).[10]

The reason for hammering this point home is that the idea that humanity is constituted by selfish monads plays a significant ideological role in sustaining capitalism. As early as 1732, Bernard Mandeville (2007) was writing about how the personal characteristics associated with the pursuit of profit—greed, selfishness, competition, etc.—are healthy personal traits that benefit the social system; hence, the subtitle for his book: *The Fable of the Bees: or, Private Vices, Public Benefits.* Written as a counter to feudal property, it expressed the coming of a new age, and with it a new set of governing personal characteristics: "what was seen in the old view as the source of self-centredness, private interest, and corruption is now the driving force of a free and equal society" (Taylor, 2004, 151). Later works of the 20th century, such as Rand's (1964) *The Virtue of Selfishness*, or the film, *Wall Street*, in which Gordon Gecko's character makes famous the phrase, "greed is good" (Stone, 1987) fulfil the same function: they promote an ideological consistency insofar as it concerns the individual as an isolate, and the particular characteristics that are viewed as being 'natural' to the self.[11] If the ideas of cooperation, social justice, socialism, empathy, altruism, etc., are assumed to be alien to the human spirit, why try to create a socialist system that is contrary to human nature? Why try to help other humans (and non-humans) if our nature is all about helping only ourselves?

In what follows, I want to extend this line of critique more broadly, to explore some other real world issues that complicate the utopian claims made by DAS supporters on the basis of our (supposedly flawed) human nature. As I hope to demonstrate, it is only by neglecting some significant realities of the capitalist mode of extraction that this technology can be understood as a liberating—and not dystopian—force. By recognizing the ways in which this neglect might set us up for catastrophe, however, I argue that we have the capacity to reorient these technologies so as to use them to secure and mediate a variety of common properties, for the benefit of all.

3. Class and the Role of the (Digital) State

To begin, it is important to note that one of the most significant absences from any discussion about the DAS is the notion of class and its relationship to the state. While there is lots of talk about getting rid of centralized institutions of power, there seems to be little under-

[10] Similarly, Simmel (1971, 217) also writes: "The general European consensus is that the era of the Italian Renaissance created what we call individuality. By this is meant a state of inner and external liberation of the individual from the communal forms of the Middle Ages, forms which had constricted the patterns of his life, his activities, and his fundamental impulses through homogenizing groups."

[11] As Teeple (2005, 21) notes: "The citizens of liberal democracies are easily convinced that the concept of human being is simply a matter of self-relatedness because it reflects the central element of their reality. That is, the principles of their daily lives are based on contractual, self-interested relations that define the system in which they live and that must be followed if they are to maintain their material existence. The concept merely takes as human the character of exchange relations in capitalist society."

standing of how or why those institutions came to exist in their centralized form in the first place.

This lack of understanding stems from the above-mentioned view that capitalism is a natural and inevitable result of our human nature (also referred to as the commercialization model of economic development).[12] The line of thinking can be traced back to the classical political economists who thought that the development of capitalism was simply a result of our innate "propensity to truck, barter, and exchange" (Smith 2001, 16). Noting that different forms of exchange have been present throughout human history, they concluded that the development of capitalism must have been a result of the lifting of the various impediments to exchange.[13]

As pointed out by Marx (1991), however, this view is one that merely reads the character of private property back into the nature of the self.[14] In doing so, the commercialization model completely neglects the actual history of the transition of capitalism (the 'so-called primitive accumulation') in which the power of the state was used by an emerging capitalist class to abolish feudal property relations, separate peasant labourers from their common lands, and introduce capitalist rationality (The Ecologist 1993; Marx, 1991; Macpherson, 2010; Polanyi 2002).

More recently, neoliberal thinkers have used the same model to justify privatization, open markets, and deregulation. Milton Friedman (1962, 12), for example, argues that competitive capitalism is the only means by which humans can resolve the basic problem of social organization—"how to co-ordinate the economic activities of large numbers of people"—without resorting to forms of coercion. Much like his intellectual forebears, however, Friedman fails to take into account "the coercion involved in the separation of capital from labour, or the possible mitigation of this coercion by the regulatory and welfare state" (Macpherson 1973, 147). While the welfare state was no doubt a class compromise, emerging to resist the widespread popular support for socialism in the post-war period, it managed to protect (for a time, at least) wholly new forms of common property in education, health care, housing, and so on, that greatly increased the living standards of millions of citizens in advanced capitalist countries (Reich, 1964).

By following the same flawed neoliberal logic, DAS supporters tend to believe that by removing the state from the equation and creating a society that consists strictly of digital exchange relations that we will enter into an epoch of *more* freedom and liberty. Indeed, as Finley (2014, par. 17) notes, "next-gen crypto-platforms paint a very attractive picture of our online future, one where users are in control, not governments or big companies." Beginning from a neoliberal subjectivity, the thinking goes that in a society in which political or social intervention is restricted so as to allow the total commodification of society (i.e., the transformation of all things into exchangeable private property), that we are much more free since we have the freedom to enter into any sort of exchange relation we desire.[15]

Of course, this is outside of the function of the code itself, which as Scott (2014, par. 42) notes, is a sort of "techno-leviathan" that mirrors Hobbes' thinking about the state. Because humans are thought to be inherently corruptible (and brutish and mean and nasty), we must necessarily exchange some of our freedom for security.[16] Instead of relying on actual people

[12] The commercialization model of economic development is the belief that capitalism emerged as a result of the build-up of commercial wealth. It includes scholars from a variety of theoretical perspectives including world-systems theorists, classical and neoclassical economists, Weberian historical sociologists, and some Marxist scholars. For more, see Wood (2002).

[13] As Wood (2002, 11) notes: "The most common way of explaining the origin of capitalism is to presuppose that its development is the natural outcome of human practices almost as old as the species itself, which required only the removal of external obstacles that hindered its realization. This mode of explanation, or non-explanation, which has existed in many variants, constitutes what has been called the 'commercialization model' of economic development, and this model is arguably still the dominant one."

[14] Critiquing Bentham for making the same mistake, Marx (1991, 759) writes: "With the driest naiveté he assumes that the modern petty bourgeois, especially the English petty bourgeois, is the normal man."

[15] As Scott (2014, par. 41) notes, conservative libertarians tend to believe that "if only hard property rights and clear contracting rules are put in place, optimal systems spontaneously emerge."

[16] Interestingly, a similar thesis is put forth by Freud (2010) in *Civilization and Its Discontents*, albeit in a different way.

to perform this function, however, the code is utilized as "a defined crypo-sovereign whose rules we can contract to."[17] As Scott (2014, par. 43) accurately notes, this "appeals to those who believe that powerful institutions operate primarily by *breaching* property rights and contracts."

In reality, however, powerful institutions are not used to break contracts, but rather, to secure those contracts, which reflect ruling class power.[18] The idea that one can simply decentralize the law completely neglects the function of law within capitalist societies. The state is not an unnatural force that confronts a natural market, but rather, an abstraction that we use to describe the political form of the relations of class dominance in various times and places, with the law itself being one particular mechanism for enforcing those relations. In the most general terms, the state is that complex of institutions that maintains the dominance of the ruling classes; defends existing property relations from basic change; and ensures that all other classes are kept in subjection.[19] The nation-state, on the other hand, is a historically specific form of state that emerged alongside the rise of capitalism and the capitalist class.[20] In most cases, the institutions of pre-existing monarchical states were merely reoriented to protect private property instead of feudal property. Through this process (which itself was the result of class struggle) the nation-state became the ultimate guarantor of property relations within the newly bounded territorial spaces achieved earlier by the various monarchies at the Treaty of Westphalia (Wood 2002).

In viewing the government and state as part and parcel of 'crony capitalism' and not capitalism itself, DAS supporters ignore the state's role in both securing the conditions for capital to exist (i.e., the so-called primitive accumulation), and the historical defence of wealth (Winters 2011). And it is only by ignoring this role that they can imagine a future stateless capitalist society as the most extreme vision of freedom. In reality, that world would likely be characterized by extreme inequality, poverty, and private authority resting on the ownership of capital: a form of "distributed capitalism" as Kostakis and Giotitsas (2014) put it, in which peer-to-peer infrastructures are utilized to accumulate and secure capital.

And we haven't even begun to speak about the class relations of such a society. Who has the ability to code these DAOs? An emerging class of capitalist technocrats? And how will material property be secured in the DAS? While legal scholars have noted that DAOs "have absolute sovereignty over their own resources" (De Filippi 2014a, par. 26), there is little discussion about how this relates to material property (e.g., land). The only solution that seems likely is either the use of already-existing states or other forms of private authority to protect material property while the "techno-leviathan" protects various forms of digital property (including financial forms such as debt, e.g.). Far from liberating us from the "terrible arc of the political", (Thiel as cited in Frank 2015, p. 27), however, this scenario seems more oppressive than ever. Many commentators have already criticized the increasing use of digital rights management (DRM) software to restrict access and control to products that could be replicated without any further additional cost (Teixeira and Rotta 2012). As O'Dwyer (2015, par.

[17] Kostakis and Giotitsas (2014, 437) make similar comments about Bitcoin, noting that "the code is in charge instead of central banks but as Lessig (2006) puts it, on the Internet the "code is law", thus pointing out the politicalness that is imbued in each piece of software. In the real world, the law enables banks to mediate credit transactions between various parties. The law ensures the credibility of contracts, protects property rights, and regulates money circulation (Lessig, 2006). Whereas in the digital world, according to Lessig (2006), code assumes this role and defines what users can and cannot do. Therefore Bitcoin as a piece of software is imbued with ideas drawn from a certain political framework."

[18] For example, Bloch (1964) provides a wealth of historical evidence on the different forms of property and contract in feudal society.

[19] As Teeple (2005, 33) notes: "The set of rights or property relations that characterize a social formation find their source in the social division of labour. They reflect the ways in which people produce and distribute the means of their subsistence. The inequalities inherent in a social formation and the social conflict that arises from the division of labour, as well as the attendant power relations are reflected in the nature and structure of the system of rights." In stateless social formations property relations will be informal or customary. In societies with a state, they will be formal and legally enforceable.

[20] As Wood (2002, 171) notes: "Although capitalism did not give rise to the nation state, and the nation state did not give rise to capitalism, the social transformations that brought about capitalism, with its characteristic separation of economic and political spheres, were the same ones that brought the nation state to maturity."

16) notes, this could be even worse in the DAS as a result of artificial scarcity and new methods of control connected to smart property: “Property doesn't disappear, but instead it is enforced and exercised in different ways. If rights were previously exercised through norms, laws, markets and architectures, today they are algorithmically inscribed in the object.” Can you imagine a world where even the most basic property relations are mediated by similar types of technologies? Surely, this would be a disaster for the vast majority of the world's subordinate classes who have nothing but their own labour power to exchange.

4. The Concentration and Centralization of Capital

The second issue that I want to deal with is the tendency toward the concentration and centralization of capital, and the extent to which Bitcoin 2.0 tech might make possible a society that is, as Fraser (2014) calls it: “commodities all the way down.”

As Marx (1991) accurately notes, capital has an inborn tendency to concentrate and centralize. In the context of capitalist competition and accumulation, there emerge increasing levels of privately held capital. This is simply the concentration of capital in greater and greater amounts as it is reinvested. Since the total social capital is split amongst many individual capitals, however, the concentration of capital also leads to its centralization in the hands of a decreasing number of capitalists through competition. As Marx (1991, 777) puts it: “capital grows to a huge mass in a single hand in one place, because it has been lost by many in another place.”

With the hindsight that late capitalism offers us, the reality of this phenomenon is increasingly clear. Through the early period of capitalist development, through the rise of imperialism and monopoly capital in the late nineteenth century, capital has become increasingly concentrated and centralized, existing today in the form of the transnational corporation (TNC). The amount of capital centralized and concentrated at this level is truly staggering. Recent research by a group of systems theorists at the Swiss Federal Institute of Technology shows that there are 1318 core TNCs with interlocking directorships, making up 80 percent of global operating revenues.[21] In their attempt to disentangle this web, the researchers also found that “nearly 4/10 of the control over the economic value of TNCs in the world is held, via a complicated web of ownership relations, by a group of 147 TNCs in the core, which has almost full control over itself” (Vitali et al. 2011, 6). Consisting mainly of major global financial institutions—e.g., Goldman Sachs Group, JP Morgan Chase, Barclays Bank—this 'super-entity' of TNCs reveals not only the hegemonic position of financial capital today, but also, the extent to which a relatively virtual form of capital is concentrated and centralized at the global level.

As noted by many authors, the earlier centralization and concentration of capital was part and parcel of the consolidation of the nation-state and the imperialist stage of capitalism (Brewer 2002; Robinson 2004; Teeple 2000). More recently, however, this growth has contributed to the emergence of non-national state forms that protect the rights of capital over multiple jurisdictions: trade agreements like CAFTA, NAFTA, WTO, and those currently being negotiated like the Trans-Pacific Partnership agreement (TPP) and the Trans-Atlantic Trade and Investment Partnership (also known as the Transatlantic Free Trade Area, or TAFTA) all function to “liberate transnational capital from the limitations of majoritarian politics” (Clarkson and Wood, 2010, 69). They do this primarily by giving corporations (usually foreign) the right to secretly sue national or subnational governments for policy changes that negatively impact the accumulation of capital.

Closely linked with globalization and the rise of financial power, this emerging non-national state has greatly reduced the prospects for (liberal) democracy by pitting national rights against an emerging framework of global rights (for capital). And while many DAS supporters claim that Bitcoin 2.0 tech will work to reduce the power of large financial firms (Allison 2015a; Jaipuria 2015), these are the very firms that seem most interested in the technol-

[21] Although the firms themselves only represent 20 percent of global operating revenues, through shares they collectively own the majority of the world's largest blue chip and manufacturing firms, which represents a further 60 percent of global revenues.

ogy (Popper 2015). Huge financial firms such as Deloitte and Goldman Sachs are already investing time and resources into the development of Bitcoin 2.0 tech with an eye towards using them to cut down on transaction costs, and further escape national-level regulation (Allison 2015b; Smith IV 2015). And not only this, they are collaborating so as to create a standardized system to buy and sell complicated assets:

> Because any innovation in this area would require the cooperation of multiple banks, the banks have had joint meetings to discuss how they could work together, often led by outside start-ups looking to provide the software (Popper 2015, par. 26).

If we treat the DAS as an extension of this general trend—i.e. the removal of barriers to exchange worldwide in accordance with the growth of capital—then the prospects for protecting commons of any sort become increasingly dire. As Harvey (2005, 165) notes: "commodification presumes the existence of property rights over processes, things, and social relations, that a price can be put on them, and that they can be traded subject to legal contract." By allowing for the development of digital contracts in such a way as DAS supporters suggest, we provide the enabling framework for the digital rule of capital: the total commodification of global society.

Indeed, De Filippi (2014a, par. 35) has already noted that if such technologies were taken over by big corporations, financial institutions, or the state, it could "lead to the establishment of a totalitarian society that is (almost exclusively) regulated by self-enforcing contracts, which establish the rules that everyone must abide by, without any constitutional constraints." The point is, however, that this is already happening! Financial institutions are some of the largest investors in Bitcoin 2.0 tech, and there is nothing that suggests that capital as a whole would not benefit immensely from the predominance of this technology, which could feasibly allow certain accumulation activities to operate outside the sphere of national legal regulation and territorial space. Taken to its full extension, this might lead to entire territories that could one day be fully managed by DAOs. One only has to look at the already-existing "special economic zones" that have been created to escape national laws and regulations.[22]

This scenario reminds me of Marge Piercy's (1993) novel, *He, She and It*, in which large corporations operate autonomous political zones. In the book, whole populations grow up, work, and die, within the corporation, fully subject to that particular corporation's law and rules of conduct—outside of these zones, and few other anarchist holdouts, the environment has been turned into a wasteland. While this example is science fiction, it is certainly a real possibility given the way in which Bitcoin 2.0 tech is proposed to work. In saying this, I do not want to suggest that I am some sort of luddite, but rather, that if the technology works as claimed, this must be considered as one of a few likely outcomes—that property relations become increasingly *denationalized* in such a way as to allow the private authority of capital to reign across the globe.[23] In this, I agree with De Zayas (as cited in Inman 2015, par. 5) when he says: "we don't want a dystopian future in which corporations and not democratically elected governments call the shots. We don't want an international order akin to post-democracy or post-law." While the nation-state remains a bundle of class contradictions it is still, to this point, the most powerful mechanism that the world has seen for achieving social rights. To simply dispose of it would likely set subordinate classes back hundreds of years.

5. Automation

The third real world issue that I want to deal with is that of automation. Many DAS supporters perceive this recent trend as the basis for a future world in which digital corporations manage totally automated production units (e.g., factories). Some even see this as moving us away

[22] A report by the World Bank (Farole 2010) notes that by 2006 there were 3500 special economic zones in 130 countries. While many are in developing countries, there are significant amounts in advanced capitalist countries as well.

[23] As Sassen (2003, 2) notes, denationalization refers to processes that do no scale at the global level, but similarly "involve transboundary networks and formations connecting multiple local or 'national' processes and actors, or involve the recurrence of particular issues or dynamics in a growing number of countries."

from capitalism proper, and toward a post-capitalist society of the collaborative commons in which everything is 'open source' (e.g., Dew 2015; Rifkin 2014).

What I'd like to do here is highlight the confusion over how Bitcoin 2.0 tech might operate within an already-existing capitalist mode of extraction, and why this process is not likely to lead to the fully-automated leisure society that DAS supporters hope. For example, Rifkin's (2014, 19) book, *Zero Marginal Cost Society*, stresses the idea that increasing automation will give way to more 'open' societies rooted in "open-source innovation, transparency, and the search for community." The logic behind such thinking is that capitalism's laws of motion will lead to both productivity increases and marginal cost decreases: when marginal cost (the cost of producing additional units of product) approaches zero, so too does profit these authors claim, since marginal cost is the point at which profit is made. Dew (2015, para 3) writes that we already see the results of this "wreaking havoc across several media industries such as entertainment, communications and publishing, as more and more content continues to be shared and made freely available across digital, collaborative networks."

While this may be true to some extent, there are a multitude of counter-examples—even in the very fields that Dew refers to as having been made redundant by decreasing marginal cost. Teixeria and Rotta (2012, 456–457), for instance, argue instead that contemporary capitalism is increasingly reliant on the production of valueless knowledge commodities, which are "privatized ideas, commodified knowledge, know-how, information, and instructions" that only employ labour for first-time production, and not continued re-production. Profit, in this instance, is secured merely by ownership, similar to a form of rent. In this context, it is questionable how a zero marginal cost society might come to exist while capitalism, with its giant corporate monopolies, are left intact. As noted by Taafe (2014, par. 26) in his review of Rifkin's book, there is a lot of discussion about the "Internet of Things," but no discussion of the transnational conglomerates that only invest and promote "products if there is profit in it." And there is little discussion about the fact that, as Bauwens and Kostakis (2014, 357) note, many TNCs appropriate "free software code for profit maximization and capital accumulation."

Indeed, a quick glance at who is developing automation technologies should give any reader pause for concern. In referring to Germany, Oberhaus (2015, par. 21, 27) notes that "the main impetus behind the ramped up industrialization […] lies not so much with the consumer, but the potential benefits to multinational industrialists that will be its earliest adopters." Siemens AG, the largest engineering company in Europe, already produces automated machines for other companies, such as BMW and Bayer, using machines "which are themselves nearly entirely automated." Similarly, Amazon's warehouses are already staffed almost entirely by autonomous robots, and the company is currently looking into using flying drones for delivery purposes (Bensinger 2013). And in my own country of Canada, large oil firms are talking about how autonomous machines might transform the Alberta oil industry (Snyder 2015).

While it is still very early, the choice of Ethereum for IBM and Samsung's proof of concept for the 'Internet of Things' suggests that Bitcoin 2.0 tech will increasingly be used to automate the management function of robotic systems (Higgins 2015). As a result, many DAS supporters seem to believe that this technology will move us toward a world of automatic luxury. Indeed, it is not uncommon to find DAS supporters quoting Keynes (2009, 365) about how automation will allow us "to devote our further energies to non-economic purposes."

The great irony, of course, is that since Keynes' time, people work more than ever; automation has not lessened our working day, but rather, increased it. And furthermore, the increasing use of this technology in the production and service sectors means greater unemployment for the majority of the people on earth, or—perhaps more likely—the further proliferation of what David Graeber (as cited in Jeffries, 2015) refers to as "bullshit jobs" (see also, Dyer-Witheford, 2015). In such a world where "code is law" (Lessig 2000), it is not clear how automation will help liberate the world's subordinate classes. Instead, it appears that it will chain us ever tighter to capital's grip, subject to new forms of rentier activity. This seems especially true considering that most of the innovation that supports the DAS has to do with financial activities (Vigna and Casey 2015; Jaipuria 2015). Not only does Ethereum's team

consist of two former Goldman Sachs employees, but Goldman has also invested $50 million in the blockchain startup, Circle (Smith IV 2015). While Buterin (2015) claims that blockchains will make financial activities more transparent, it is not clear how they will reduce the social power of large financial TNCs, and the production firms linked to them.

6. Conclusion

Outside of the real world issues that I have examined, there is good reason to question the utopian narrative of the DAS. While the example of a washing machine ordering its own detergent is sufficiently domestic to obscure other uses of this technology, it is important that we recognize the destructive potential. With the coming of autonomous machines, we might soon live in a world where drones hire other machines for military purposes, or where in-body nano-technology autonomously negotiates with other technology outside your body (and perhaps, without our consent). Indeed, prominent individuals in the science and tech industry such as Stephen Hawking, Elon Musk, and Steve Wozniak, have already called for a ban on "offensive autonomous weapons" (Asaro 2015, par. 1).24 There is certainly no denying the potential of Bitcoin 2.0 tech, but it is this dark side that concerns me because it is necessarily opaque and hard to predict. Taken to its logical conclusion, however, the DAS can only appear as a utopia if one has totally expunged power and coercion from their analysis of social reality.

This is not to suggest, however, that all supporters of the DAS share this libertarian vision. There are many individuals who believe that Bitcoin 2.0 tech might better protect "the perimeter of the commons" by "empowering commoners to decide their own fate" (Bollier 2015, par. 21; see also, Clippinger and Bollier 2014). While there is no techno fix to the inherent contradictions of the capitalist mode of extraction, Bollier (2015, par. 22) notes that this technology could be used to leapfrog "over some of the dysfunctional politics and bureaucratic treachery that is rife in conventional institutions." Furthermore, Bauwens and Kostakis (2014) note that many of these technologies are able to scale up and down, making it possible to create distributed collaborative organizations (or 'open co-operativism' as they call it) that could be used to help smaller, regional areas protect their own commons—whether they be in the form of healthcare, education, water, air, internet, knowledge, and so on.25 In other words, we might be able to use DAOs to automatically manage common property resources—and without many of the problems typically associated with those regimes.

While this world is still far off, I agree with Bollier (2015, par. 22) that it "is a rich horizon worth exploring." But I think that we can only explore this rich horizon if we expunge ourselves (and the technology itself) from the type of thinking that views that state as an unnatural outgrowth whose only function is to restrict our inherent propensity to exchange. This view not only neglects that most technological innovation is state driven (Mazzucato 2014), but that the state can also be used to protect certain things from commodification, thus guaranteeing some of our freedoms against the tyranny of the market. Indeed, as Franklin (1999, 100) notes,

> what turns the promised liberation into enslavement are not the products of technology *per se* […] but the structure and infrastructures that are put in place to facilitate the use of these products and to develop dependency on them.

[24] Interestingly, "in a political loop-the-loop, a bill in North Dakota originally intended to limit the power of police drones actually permits unmanned aerial vehicles to use rubber bullets, pepper spray, tear gas, sound cannons, and Tasers" (Staedter 2015, par. 1).

[25] Frank (2015, 36) provides some further examples: "A group of friends or strangers, distributed throughout a neighbourhood or around the world, could set up a mutual-aid society without involving an insurance company. Each person would pay into a contract that would automatically release money to an injured or unemployed party when certain mutually agreed-upon conditions were met. This group might get more ambitious and create a digital community currency, with units distributed to all members on an egalitarian basis. They might build a digital voting system; the blockchain would guarantee transparency. If these experiments worked, the group could vote to accept new members, which would make the mutual-aid system more robust and the community currency more useful. As real and virtual imbricated further, these modest cooperative entities could and would scale up."

To make certain that Bitcoin 2.0 tech provides the basis for progressive human development, we must ensure that it is used to secure our social rights, as opposed to a means of avoiding the state by escaping to digitally-mediated private spaces. Indeed, as Harvey (2015, par. 33) notes, it is important that people on the left take this technology seriously to "make sure this is not orchestrated as a right-wing gesture as happens with something like Bitcoin." As he continues: "Is there a way where we on the left can construct an alternative monetary system, which is actually much more democratic and much more socially constructed?" Only time will tell. But what is certain is that liberation will not come from a world subsumed by exchange relations, as many DAS supporters currently claim. It is in this sense that we must, as Franklin (1999, 133) writes, "protest until there is change in the structures and practices of the real world of technology, for only then can we hope to survive as a global community."

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Monetary Materialities of Peer-Produced Knowledge: The Case of Wikipedia and Its Tensions with Paid Labour

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Abstract: This article contributes to the debate on the possibilities and limits of expanding the sphere of peer production within and beyond capitalism. As a case in point, it discusses the explicit and tacit monetary dependencies of Wikipedia, which are not only ascribable to the need to sustain the technological structures that render the collaboration possible, but also about the money-mediated sustenance of the peer producers themselves. In Wikipedia, the "bright line" principle for avoiding conflicts of interest has been that no one should be paid for directly editing an article. By examining the aftermath of the Wiki-PR scandal, where a consulting firm was allegedly involved in helping more than 12,000 clients to edit Wikipedia articles until 2014, the goal of the analysis is to shed light on the paradoxical situation where the institution for supporting the peer production (Wikimedia Foundation) found itself taking a more strict perspective vis-à-vis commercial alliances than the unpaid community editors.

Keywords: Wikipedia, Wiki-PR, Materialities, Peer Production, Commons

1. Introduction

Peer production has often been portrayed as a potential complement or a radical alternative to capitalism (e.g. Moore 2011; Rigi 2013). As an early and prominent figure in the debate, Yochai Benkler (2002; 2006; 2011) depicted the regime of *commons-based peer production* as a revolutionary social form that will eventually transform the ways of organizing production in the contemporary economy. He argues that peer production has "systemic advantages" over markets and firms in allowing "larger groups of individuals to scour larger groups of resources in search of materials, projects, collaborations, and combinations than is possible for firms or individuals who function in markets" (Benkler 2002, 381, 376–377). Still, Benkler never moves out of the capitalist paradigm, but rather sees capitalism as being vitalized by peer production, not superseded by something new and different.

One of the focal lines of inquiry with regard to the possibilities of expanding the peer-production regime towards the boundaries of capitalism has been the question of the conditions of its social and material reproduction, and especially the prospect of taking a step from the digital co-production of information towards the distributed production of tangible goods (Siefkes 2008; 2012; Davey 2010; Troxler 2010; Kostakis 2013; Kostakis and Papachristou and 2014; Kostakis, Niaros and Giotitsas 2014). Indeed, for a regime of peer production to be sustainable and generalizable, it has to account not only for the maintaining of the socio-cultural practices of benevolent sharing, but also for the material, technological and bio-physical resources necessarily interlinked to the chains of symbolic production. In addition, to construct a regime of commons-based production *beyond* or *regardless* of capitalist relations of production, there has to be a framework that provides safeguards against the pitfalls of co-opting the peer production processes back to the circulation of commodities and to the accumulation of capital (Federici and Caffentzis 2013).

In this article, we seek to contribute to the unveiling of the materialities of commons-based peer production by examining the lines of conflict in the economic relations of Wikipedia. In specific, we will interrogate the disputed boundary lines in the uses of paid labour in producing and reproducing Wikipedia as a collection of open-access knowledge. Some of the paid

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positions related to Wikipedia, such as the "Wikipedian in residence" scheme tailored for museums, libraries, and other non-profits, are almost universally accepted within the editing community, while others, such as working for a public relations agency, are fiercely contested. In our understanding, these tensions reveal and highlight some of the highly important but mostly unspoken political positions within the project. The disputed cases of paid editing and paid advocacy can be seen to pose risks to the encyclopaedic ideals (Osman 2014) but also, perhaps more unexpectedly, to introduce new emancipatory advantages (Lund 2015a).

In the analysis, we will introduce the concept of *monetary materialities* by which we refer to the flows of finance that are indispensable for sustaining and expanding Wikipedia as a viable and valuable project. In the widest sense, these materialities include, first of all, the operating costs of the technological infrastructures intermeshed with the informational content of the encyclopaedia, and secondly, the monetary income required by its voluntary contributors to maintain their livelihoods. It is our conviction that these elementary preconditions of social reproduction – as well as the plethora of planetary assets such as metals and oil backing the digital infosphere – have too often been overlooked in the discussions on the commons and peer production (for notable exceptions, see Bauwens and Iacomella 2012; Federici 2012).

From the point of view of Wikipedia's neutrality ideals, the monetary flows for funding its material necessities should be kept far away from the symbolic flows of information that constitute the sought-for content of the encyclopaedia (Osman 2014, esp. 597). Still, Wikipedia has seen plenty of events that have disturbed the "bright line" that calls for excluding paid advocates. As Wikipedia has reached a critical mass and proved capable of providing a broad range of quality information, it has also become an attractive platform for commercial actors to promote their interests (Lund 2015b).

As a starting point to the discussion, we will reflect the case of Wiki-PR, a consulting firm allegedly involved in helping more than 12,000 companies to edit Wikipedia articles for their commercial interests. Accused of violating the community rules, Wiki-PR, including all of its employees, owners, and contractors, was banned from Wikipedia in early 2014. The scandal was accompanied by policy proposals for and against regulated paid advocacy, thus opening up a space for the discussion about the confluence of commercial and non-commercial motivations. As the community process did not result in a consensus for ruling out paid advocacy, the governing body, Wikimedia Foundation, intervened by introducing an amendment to the Terms of Use that apply to all of its projects, effectively prohibiting non-disclosed paid editing.

Within this context, we ask: *how do Wikipedians perceive and negotiate the alliances of commons-based peer production with the capitalist economy in terms of reproducing the sustenance of their own lives and the informational use value of the project?* While our implications are not confined to Wikipedia as a particular case, we consider it as an instructive example in the debates on the commons as a breeding ground for radical politics (e.g. Hardt and Negri 2009; Mattei 2011; De Angelis 2012; Dardot and Laval 2014; Caffentzis and Federici 2014).

Based on an analysis of *The Signpost*, a community newspaper of English Wikipedia, and the internal discussions about the changes in policies and Wikimedia Foundation's Terms of Use, we will highlight three aspects of the Wiki-PR scandal. First, we will examine the different perspectives from which the paid advocacy was represented as the events unfolded. Second, we will show how in the course of the consequential votes about the proposed policies against paid advocacy the response from the editing community was relatively more liberal than the one from Wikimedia Foundation. Third, we will discuss and interpret the politics of the proposed changes in the terms of use of the Wikimedia projects by the foundation that was later accepted by the community with a few amendments. To support the analysis, we will begin by discussing the socio-technical materialities of peer production in general, and then the monetary materialities of Wikipedia in particular.

2. Socio-Technical Materialities of Peer Production

The concept of peer-to-peer technology has been used as an umbrella term to describe everything from YouTube, operating on a fully commercial and closed platform, to open networks using the BitTorrent protocol for co-operation. For example, Pouwelse et al. (2008, 703) understand the paradigm of peer-to-peer broadly as an "enabling mechanism for human interaction and cooperation on an unbounded scale that lacks central points of authority and is helped by mutual donations of computer resources".

Wikipedia, with its 128 million articles in more than 280 language versions, is unarguably the largest existing collection of organized digital knowledge created by voluntary contributors and thus, a paragon of networked mass collaboration. In addition to being a huge "pool of immaterial labour" (Corsani, Lazzarato and Negri 1996) and a "massively multi-user knowledge management exercise" (Bruns 2011, 134), it is supported by a dense mesh of material structures: data centres, telecommunications cables, cooling systems, and all of electrical electronic energy required to service about 7,700 page requests per second (in April 2015) (Wikimedia Stats 2015).

When discussing the *socio-technical materialities*[1] of Wikipedia as a platform of peer production, it is worth noting that while the pool of knowledge is created and maintained in a largely self-organized social process, the technological resources are, for the most part, owned and managed by a central governing body, the Wikimedia Foundation. These resources include, among others, the data centres in Ashburn (Virginia), Amsterdam, San Francisco, and Carrolton (Texas), providing the calculation power, storage capacity, and the high-speed Internet connections for serving the close to 500 million users of Wikimedia projects[2]. (Meta-Wiki contributors 2015b; Wikimedia Stats 2015; Paumier 2013; Verge 2013.)

Wikipedia is run mostly on open-source software. In addition to GPLv2-licensed MediaWiki, Wikimedia Foundation's in-house solution for content management, Wikipedia's architecture includes an array of open-source software from Ubuntu (the operating system used in the servers) to PowerDNS (for distributing the page requests depending on the location of the client), Linux Virtual Server (for load balancing), and MariaDB (for database management) (Meta-Wiki contributors 2015b). Thus, the technological backbone of Wikipedia is based on a hybrid economy: the centralized, money-mediated and proprietary hardware layer, and the decentralized, commons-based open-source software layer.

Analytically, it is important not to conflate the socio-cultural practices of sharing (the mutual contributions of time, knowledge, and other resources at hand) with the technological structures that mediate the process. Technological factors of peer production do not determine the success or failure of cooperation in a peer-to-peer scheme, but they might still have some effects on the formal and informal codes of conduct within a commons. There is a difference between the more centralized platforms running proprietary software and holding a majority of the rights in private hands, and the more decentralized platforms and architectures, such as Wikipedia's, that reserve (and can reserve) more rights for the rank and file of the participating commoners. Decentralized platforms that distribute the rights more horizontally within the community often utilize copyleft licensing in tandem with the formal and informal codes of conduct that encourage and reward altruistic modes of behaviour.

Within the peer-to-peer debates, Michel Bauwens (2009) has stressed the relation between the social and technological aspects of peer production. He sees peer production as a relational dynamic that could mediate relations between machines but more importantly with

[1] As Leonardi (2012) remarks, there has been a broad overlap in the uses of terms such as "materiality", "sociomateriality" and "socio-technical systems". By socio-technical materialities, we refer here to the mutually constitutive and mutually nourishing interlinkage between the socio-cultural practices and the technological layers (hardware and software) of cooperation. In the case of Wikipedia, this implies that the tools of cooperation are informed by the concrete needs arising from the process of *commoning* (Linebaugh 2008; Esteva 2014), but also that the modes of behaviour and codes of conduct are influenced by the technological solutions (Benkler and Nissenbaum 2006).

[2] These include, in addition to Wikipedia, a free dictionary (Wiktionary), two full-text collections (Wikibooks, Wikisource), a multimedia repository (Wikimedia Commons), a data repository (Wikidata), and several others. (Wikipedia contributors 2015b; Wikimedia Foundation 2015.)

relations between human beings: the peers. It is in this context that he makes a distinction between peer production and Web 2.0 services. When capitalist actors like Flickr (the *quasi-commons*, as Brown 2012 puts it) and YouTube certainly make participation possible and encourage it, they mainly invite participants to be involved as *individuals*. There is no creation 'in common', except for the common sphere for the exchange of activities. He calls this a *sharing mechanism*, whereas peer production is instead grounded in a *commons mechanism* where production occurs in a form of voluntary exchange between equals in horizontal networks within the commons (Bauwens 2009, 125–127; Gye 2007a; Gye 2007b).

Over the course of the modern history of information and communications technology, a less challenged assumption behind its political promise has been that, in the long run, the cost of reproducing information will approach zero, as Moore's law will make technology exponentially more affordable (see Negroponte 1988). The technological layers of production, while still necessary, have been understood to become a mere backdrop to the more valuable operations in the value chain—it is, for the production of the informational or "cognitive" commodity (Moulier Boutang 2011, 50–56; cf. Starosta 2012). This prospect, for its part, has led prominent network society theorists such as Jeremy Rifkin (2014) to estimate that the possibilities for the costless sharing of information would bring us to a profound socio-economic transformation: in effect, it would gradually lead to capitalism becoming inherently 'communist', as there is no legitimate reason for denying access to the common prosperity (cf. Virno 2004, 110; Beverungen, Murtola and Schwartz 2013).

To push the point slightly further, we could argue that the imageries of digital production have been driven by an unquestioned *credo of affluence*. This has been particularly the case in the discourses of free and open-source software, peer-to-peer production, and the Creative Commons. In contrast to the scarce world of natural commons—tillable land, drillable oil, potable water – which from day one of environmental awakening have been identified as vulnerable to a tragically uncoordinated overexploitation (Hardin 1968), the theorists of digital commons (e.g. Boyle 1997; Lessig 2000; Litman 2001) broke ground for the notion of the "infosphere" of Internet as a realm of abundance, where the tragedy of the commons would be overturned by a sharing economy for the benefit of all. Once the artificial barriers of sharing (such as overregulated intellectual property rights) have been dismantled, a veritable "comedy of commons" (Rose 1986) could take place and the creation of prosperity could derive from a "social commerce of the human spirit" (Bollier 2001). Of course, the dichotomy between scarce nature and "non-scarce" digital information is far from obvious, as the prerequisites for actually producing and consuming the information—mainly, time—are practically limited.

While the extent of the social and cultural implications of the ICT revolution can hardly be questioned, overly optimistic views on peer production might actually hinder the critical potential of the concept itself. Media philosopher Matteo Pasquinelli (2008, 72–73) has described this misconception as a "digitalist utopia", where production is portrayed as a purely symbolic exchange between self-standing individuals, largely independent of the physical, biological, financial or socio-cultural conditions of sustaining the production. The "ideology of digitalism" promotes an understanding of energy-free production of data which is "virtually free from any exploitation, tending naturally towards a democratic equilibrium and natural cooperation" (ibid, 72), also neglecting the question of the environmental sustainability of distributed production (cf. Kohtala 2014; Kohtala and Hyysalo 2015).

In contrast to the digitalist abstraction, we conceive the social processes of digital production as being inherently and inescapably material, but vice versa, we see the involved materialities as always and already socio-culturally shaped: they do not exist "behind" social action and cultural norms as *infra*structures nor "above" them as *super*structures, but rather at the very same ontological level (cf. DeLanda 2002; 2006, 4–5).

Certainly, peer production as a socio-cultural practice is not *reducible* to its material constituents. It is a novel form of co-production, but still its potential in reshaping or partially transcending capitalism cannot be accounted for without thoroughly examining its dependencies on the money-mediated economy and the Earth's planetary boundaries. Without scrutinizing the material conditions of reproduction of the digitally mediated production processes,

there is a risk of contributing to a romanticized view of peer production, a position which would serve neither the purpose of analytical clarity nor the efforts for building ecologically and socially sustainable futures.

The materialities of the digitally networked production usually manifest themselves only in the event of a malfunction, external disruption, or social or political conflict. This is not only an accidental feature of the digital infosphere, but also an intended purpose of digital businesses that stress the importance of a seamless user experience at the cost of transparency. The purported goal of the service providers is, as Google CEO Larry Page phrases it in Google's 2011 Annual Report, that "technology should do the hard work" while users can do what makes them happy: "living and loving, not messing with annoying computers!" (Google 2011, ii; cf. Lovink 2009). For another example, Apple has undoubtedly been one of the forerunners in advocating an intuitive approach to computing and mobile devices. In the 2011 WWDC fair, Steve Jobs mentioned that for ten years already, they had been working "to get rid of the file system so the user doesn't have to learn about it" (WWDC 2011). In terms of epistemic self-governance, Apple's ambition is rather far-reaching in trying to convince users that they should not bother where their data are logically or materially situated—or, by extension, how it is used, by whom, and for which purpose.

In case of Wikipedia, the public expectations for transparency are evidently higher than in the corporate Internet settings. Wikipedia can be conceived as an ambitious experiment of participatory democracy, armed for producing common good for all. Even while it proclaims itself as a politically neutral project, it is starkly ideological in a sense that it suggests very high standards of democratic participation and access to knowledge. Obviously, the reality of Wikipedia's production process might not meet all of the ideals; in contrast, there has been a constant worry about a systemic bias for educated Western white male contributors (Brake 2014, 599). There are certainly a number of "digital divides" behind the façade of equality. Also, as concluded by José Felipe Ortega in his quantitative analysis of ten biggest language versions of Wikipedia, the division of labour within the community is rather skewed, and there is a "heavy dependence" of Wikipedia on the work of a small core of very active editors. In Ortega's data, less than 10 % of authors made more than 90 % of the contributions of content. (Ortega 2009, 106–107.)

3. Wikipedia's Monetary Materialities

At the surface level, the operational logic of Wikipedia seems markedly detached from commercial dependencies and openly unsympathetic towards them: after all, Wikipedia is an "encyclopaedia that anyone can edit"—a free service hosted by a non-profit foundation. It is based upon encyclopaedic ideals not so dissimilar to the ones of scientific research: communalism, universalism, disinterestedness and organized scepticism (Merton 1973). However, even Wikipedia cannot completely rule out the realm of the prevailing monetary economy. While the digitalized knowledge itself might be free and open, the material structures of its production and reproduction are still largely governed by the ordinary laws of the market.

In a simplified view, Wikipedia is sustained by two major income streams: 1) the donations of money (in US dollars) for the Wikimedia Foundation (WMF) and 2) the unpaid work of the contributors for providing the content of Wikipedia. The donations are channelled by WMF to wages, grants to their local subsidiaries, and other expenses such as infrastructure costs, while the unpaid work is accumulated directly in the informational content of the encyclopaedia (Figure 1). In the following paragraphs, we will discuss the two tiers of Wikipedia's gift economy: first, the donations of money, and second, the donations of work time.

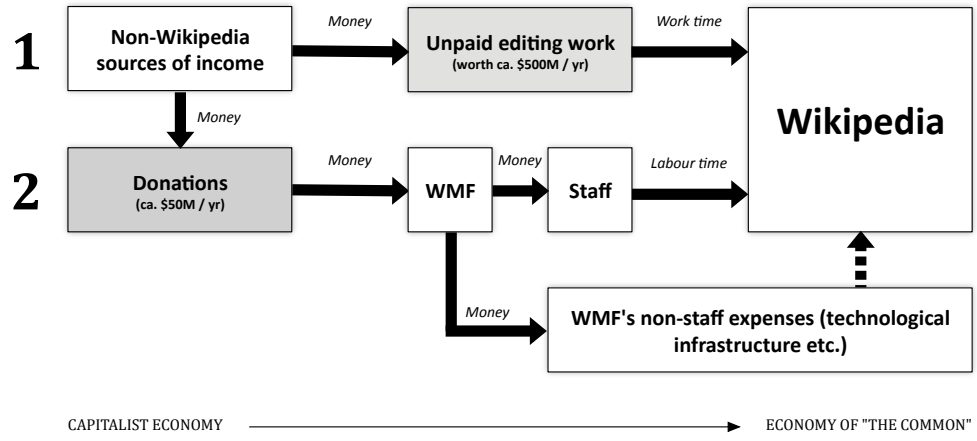

Figure 1: Wikipedia's two-tier gift economy: donations of money and donations of time.

3.1. Donations in Money to Cover WMF's Expenditure

Wikimedia Foundation (WMF), the governing body of the peer-produced encyclopaedia, has annual expenses of about $50 million per year (2013–2014[3]). Salaries and wages constitute the biggest category of expenditure, just slightly under $20 million in 2013–2014. Since the establishing of the foundation in 2003, staff costs have been rising rapidly, whereas the cost of Internet hosting and other non-staff expenses have remained relatively modest. The growth of salaries and wages correlates with the impressive success of the latest fundraising campaigns—the one in 2013–2014 yielded over $51 million, doubling the total amount of donations in the span of two years (Figure 2).

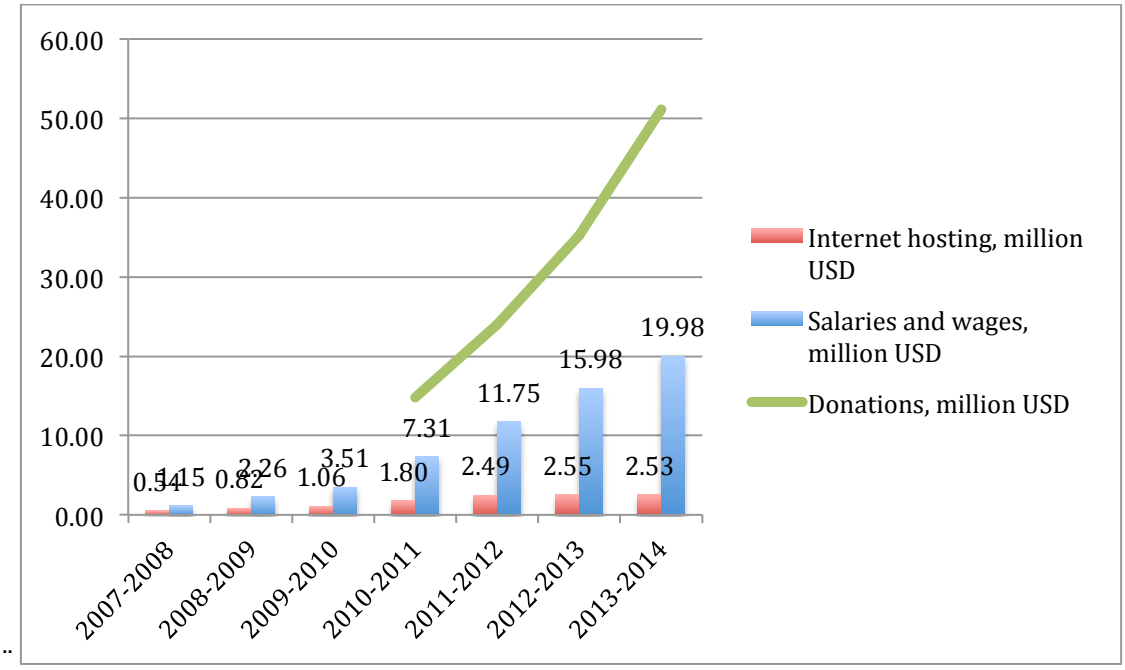

Figure 2: The growth of major expenses of the Wikimedia Foundation in 2007–2014.

For 2014–2015, WMF planned to hire 49 additional staff members, adding up to 240 employees (WMF Annual Plan 2014–2015, 9–10). The rapid increase in WMF's paid staff has

[3] The fiscal year of WMF lasts from 1 July to 30 June, so e.g. 2013–2014 refers to a single year.

given rise to criticism concerning whether the foundation would even need the donations that it is asking for (Orlowski 2012). The growth of the paid staff might increase the tension in relation with the contributors working without compensation.

WMF's expenses are financed almost exclusively by donations from individuals, commercial firms, non-profits and national states and with some minor income streams from the sales of updates and feeds to search engines. The donation base of WMF is relatively wide and has been growing: in the financial year of 2013–2014, 2.5 million people donated an average of $15.[4] As only two in a thousand persons donated over $1,000, it can be seen that the bulk of financing of Wikimedia Foundation comes from the very heterogeneous masses. Thus, it would seem for Wikipedia to be in a relatively strong position to block any potential attempts to influence the substance of the encyclopaedia through bribery. Supporting these observations, the earlier study of Swedish Wikipedia (Lund 2015a) shows that the necessary self-confidence of the editing community to build alliances with capital for the benefit of the project depends very much on the plentitude of the donations, as well as the use of the core content principle of Neutral Point of View (NPOV) to curb capital's boundless desire to make profit in whatever manner as possible.

3.2. Donations of Time by the Unpaid Editors

The monetary flows that allow for the continuity of Wikipedia's technological infrastructure and its paid staff are only one side of the coin, the other being the unpaid work providing the informational content that makes Wikipedia valuable to its users and potentially also to the commercial actors in its margins. In 2012–13, volunteer contributors made over 160 million edits, added almost 5 million articles and uploaded more than 4 million new images, audio files and video files (WMF 2014).

While the amount of donations is revealed in WMF's financial statements, the value of the unpaid labour is obviously more difficult to estimate, but there have been a few attempts to do exactly that (Juhel 2011; Geiger and Halfaker 2013; see Band and Gerafi 2013, 4).

Vincent Juhel used several methods to derive the amount of working hours and/or their economic value. For example, he calculated that an annual increase of 70 million characters in the French Wikipedia would equal €32.3 million if written by freelance journalists at the standard rate of 57.74 euros per 1500 characters. Assuming a monthly salary of €3,000, this adds up to about 900 full-time jobs for the French Wikipedia alone (Ibid. 16). A comparable figure is reached by multiplying the number of annual edits by an estimated average time of 10 minutes per edit (Ibid. 15). If applied for all language versions, this formula yields an expenditure of about €431 million ($485 million), i.e. 12,000 full-time jobs.[5] Juhel's estimates are supported by findings of Geiger and Halfaker (2013). Analysing the English Wikipedia's log files, they came up with a figure of 425,000 labour-hours per month in 2012, which would extrapolate to about €437 ($492 million) per year, using the same assumptions as above.[6] If the scale of these estimates is approximately correct, it seems that the economic value of the unpaid work (if it were to be purchased from the market) is almost ten times the sum of Wikimedia Foundation's annual income in money.

One of the dismissed or underemphasized aspects of the digitally networked peer production has been the cost of reproducing the labour power, or in the case of Wikipedia, the reproduction of the voluntary workers or Wikipedians. While the majority of Wikipedians still earn their living outside of the project in entirely capitalist relations of production that have little to do with the "commonist" gift economy (Schantz 2013, 75–82) of Wikipedia, there are an increasing number of possibilities of getting paid either within the project, or by using the

[4] This figure, which is reported in WMF's Annual Report, is the average sum of donations under $10,000. If the larger donations were included, the average would be $19.14, as indicated in the actual fundraising report. (See Meta-Wiki Contributors 2015a.)

[5] This estimate is our calculation based on the "Wikipedia Edits per Month" statistics (Wikimedia Stats 2015), from May 2014 to April 2015. The assumptions are: 10 minutes per edit; 140 editing hours per month; a salary of €3,000 per month, including ancillary costs.

[6] Assuming that the share of the English Wikipedia in total edits is approximately 25% (as it was in April 2015, according to Wikimedia Stats 2015).

skills developed within the editing community for activities outside or on the fringe of it. For example, the Swedish Wikipedia has developed a project together with the Swedish National Heritage Board (Riksantikvarieämbetet). The Board's staff will be educated in how to edit Wikipedia by a Wikipedian in Residence. Subject specialists, wage labourers of the Board, are thus getting paid in order to be educated about how to contribute to Wikipedia, and their instructor, also paid by the Board, has been selected among the peers in the Wikipedian community.

4. Wiki-PR and the Disgrace of Paid Editing

Ganaele Langlois and Greg Elmer (2009, 775) have argued that Wikipedia functions as an arena for political campaigning and for implementing companies' PR strategies (Langlois and Elmer 2009, 775). Even Wikipedians themselves have pointed out that the success of the site under the new millennium's first decade has created a constant problem to keep away from all planted ads and junk in the form of sales brochures (Lih 2009, 226).

A way of influencing a company's presence in Wikipedia, then, is to hire a PR consulting firm. An article published in *Lawyers Weekly* in 2009 gives us an example of how business people try to understand how Wikipedia functions. At the moment, the encyclopaedia has relatively few articles on small and medium-sized companies. As a result of the ban on ads in Wikipedia and the required objective way of editing, the journal addresses the "problem" with "marketing guru Larry Bodine" to get a picture of how companies could contribute in a correct way. The advice given in the article is that "small firm lawyers" should engage someone to write about the company without advertising. They should keep the text short and back it with a historical section and external sources. The guru also stresses the importance of checking the article continuously as well as being rather defensive in attitude (Rebello 2009,).

Kaplan and Haenlein point out that that if someone today googles a company name, the Wikipedia article will typically be among the top results. This could be problematic for the companies that historically have grown accustomed to being in control of the information about them. The authors give ten pieces of advice with regard to social media, and one of them is that you should not lie when you have to do with Wikipedia. As an example, they mention an owner of an aqua amusement park that tried to improve on the park's article with the help of a PR firm and totally failed. (Kaplan and Haenlein 2010, 60, 62, 67.)

How commercial interests and their intervention in the project affect the participation in the project has, to our knowledge, not been widely addressed in research, except for the Spanish fork that stands out in this context. The resulting competition between two different encyclopaedias hampered the development of the Spanish Wikipedia for several years (Guldbrandsson 2008, 146; Lih 2009, 9,137).

However, the case of Wiki-PR and the consequential policy proposals have been previously studied by Kim Osman (2014), who concluded that the commonplace image of Wikipedia as an example of the potential of Internet to support open, free and non-commercial cooperation, is often confused with how reality looks like within its peer production. We agree with Osman that the romanticized imagery of digitalism is a theoretical dead end, but in contrast to his critique's assumptions, we contend that it was not better before. In Wikipedia, paid editing has been critically discussed for many years, and it also has to be noted that Wikipedia did not start out as a non-commercial project, but rather has become less commercial in some respects since the beginning.

4.1. The Unfolding of the Wiki-PR Scandal in *The Signpost*

In August 2012, a Wikipedia user, Doc Tree, was editing an article on the encryption company CyberSafe in August 2012. On the surface, the article seemed to meet Wikipedia's guideline of notability, but when looking into the citations, none of the references dealt with the company. When the article was suggested for deletion, numerous people showed up to defend it. The editing histories of these users were either non-existent or related to the articles about small firms. These people had been hired by a firm called Wiki-PR, which in turn was a subcontractor of thousands of businesses that wanted to influence and improve their pres-

ence in Wikipedia (Owens 2013). The story was followed up by the UK-based *Vice* magazine that portrayed Wiki-PR as a multi-million-dollar business, having broken several policies and guidelines on the English Wikipedia as well as editing and maintaining thousands of articles (The ed17 and Jayen466 2013).

One of the companies involved, Priceline.com, told *Vice* that they were using Wiki-PR to get a presence in the encyclopaedia for all of their brands. The manner of editing was unusual. The initial draft was created on a user subpage by a Wiki-PR employee and then moved to the article space the next day, thus bypassing "the gatekeeping new page patrol" (The ed17 and Jayen466 2013).

All of this led Sue Gardner, then executive director of Wikimedia Foundation, to issue a press statement that was reprinted in full in English Wikipedia's community newspaper, *The Signpost*. In the statement, she declared that "[e]diting-for-pay has been a divisive topic inside Wikipedia for many years, particularly when the edits to articles are promotional in nature". At the same time as she stressed that paid advocacy editing was "extremely problematic", while singling out the editing of a university professor in his/her area of expertise as unproblematic. The statement claims that, "editing by using sockpuppets[7] or misrepresenting your affiliation with a company is against Wikipedia policy and is prohibited by our Terms of Use". According to the argument, the companies engaging in self-promotion were being highly criticized by the general public as not in line with "Wikipedia's educational mission" (2013).

Jordan French, the Wiki-PR CEO, issued his own press statement claiming the company was counselling its clients "on how to adhere to Wikipedia's rules". More importantly he stressed: "We do paid editing and not paid advocacy. Our primary goal is to improve Wikipedia. We're part of the fabric of Wikipedia – an integral part – and useful where volunteers don't want to or cannot put in the time to understand a subject". He ends the statement with the claim that there is "a rather silent majority on Wikipedia that supports paid editing" (Jordan French ref. in Go Phightins! et al. 2013).

We claim that an interesting debate starts here that could be interpreted in rather the opposite way compared with Osman's analysis. We will focus on one specific phase of events in our analysis: the subsequent successful amendment in the Terms of Use as a result of the Wiki-PR scandal.

Leading up to the change in the Terms of Use of all Wikimedia projects, Wiki-PR received a community ban and a cease-and-desist letter sent by the Wikimedia Foundation. The ban of Wiki-PR was voted on and enacted by volunteer Wikipedians because the company had proven unable to adhere to basic community standards, and to be unbanned Wiki-PR had to comply to three directives: divulge a list of all past "sock and meatpuppet accounts that they have used", divulge all articles they edited for financial benefit, and pledge to edit "only under transparent, disclosed accounts" and adhere to content policies (The ed17 and Tony1 2013).

4.2. Failed Policy Proposals

Following the revelation of the Wiki-PR scandal in November 2013, there were three active policy proposals for regulating paid editing and/or paid advocacy in the English Wikipedia: "No paid advocacy", "Paid editing policy proposal", and "Conflict of interest limit". The oldest of these three, No paid advocacy, had already been drafted in late 2011, reflecting the strong opinions against the use of paid labour as expressed by the Wikipedia co-founder and "constitutional monarch" Jimmy Wales.[8] In the opening discussion on the talk page, there is a dispute as to whether Wales had the authority to mandate such policy merely by taking it into practice, which would leave the community the role of merely explicating the norms that *de facto* were already in place.

[7] The use of multiple Wikipedia user accounts for an improper purpose is known as *sock puppetry* and the different false user accounts as *sock puppets*. When a Wikipedian try to promote his/her cause by bringing his/her friends to the argument, these friends are called *meat puppets*.

[8] While Wikipedia has often been portrayed as an experiment of non-hierarchical, commons-based governance, Wales has retained a set of exceptional privileges that allow him to overrule the community decision in the last resort, which has led some to describe him as the "benevolent dictator" of Wikipedia (Meta-Wiki contributors 2013b).

However, the discussion on “No paid advocacy” quickly led to lengthy debates on delineating the subsets of paid editing activities that should or should not be allowed. In specific, there was a lack of consensus on what would constitute “advocacy”, how it would be identified, and whether the sort of activities would have been already governed by the established core policies such as “Neutral point of view”, “Verifiability”, and “Biographies of living persons”. In comparison with ”No paid advocacy”, the “Paid editing policy proposal” was slightly more liberal towards the inclusion of paid editors, and the third proposal, “Conflict of interest limit”, fell somewhere between the two.

The majority of the participating editors rejected all three proposals. “No paid advocacy” gathered 229 responses[9], 72% of which were against introducing the new policy.

In contrast to what was claimed by some of the discussants and also by Jimmy Wales, it became clear that there was no consensus within the editing community—in this case in the English Wikipedia, but probably also more generally—regarding how to react to the practice of paid editing.

Osman (2014) identifies 21 different categories or positions in the discussions vis-à-vis the three proposals regarding prohibition or alternatively restriction of paid editing and paid advocacy within the English community, even though all three failed to be accepted. Ten of these categories opposed the elaboration of a policy against commercially grounded editing, nine gave their support to such a policy, and two were neutral but demanded clarifications on the wording of the policy. Some 300 Wikipedians took part in the discussions, and the proposal No Paid Advocacy attracted more discussing participants (256 of them) than the others. Interestingly, there was only one comment in the debate about the involvement of WMF in the question. The community seems to view this very much as their question (Osman 2014, 601–602).

Nine categories out of 21 being explicitly in favour of a policy against paid advocacy is a rather strong reaction against paid advocacy by companies, considering the benefits of the more and more common use of external actors’ wage labour in the editing the Wikipedia, and the long trajectory of awareness of paid editing within the peer production without strong protests being launched against it. Instead of interpreting it as a defeat against the logics of capital, it could be seen as a strong reaction for a need to regulate the editing of external actors. At the same time, we see that there is a limit to the political critique. Institutional involvement from the foundation is generally not favoured, which could be a sign of right-wing libertarianism as well as a left-wing stance.

4.3. Amendment in the Terms of Use of the Wikimedia Projects

In February 2014, *The Signpost* reported that WMF proposed to modify the Terms of Use for all the Wikimedia projects. According to the report, the debate extended to 50 sections on the talk page but showed a majority in support of it. The new Terms of Use were targeted to explicitly ban “undisclosed paid editing”. The author contends: “This is the Foundation’s first major move against the much wider category of paid *editing*, rather than *advocacy*, putting it all in the category of ‘deceptive activities’” (The ed17 2014a). In the proposal that prohibits misrepresentation of affiliation, impersonation and fraud it is required that users disclose their employer, client and affiliation “with respect to any contribution to any Wikimedia Projects” for which they receive compensation. The disclosure could be made as a statement on the user page, on the talk page of the article, or as a statement in the edit summary (The ed17 2014a).

The changes in the Terms of Use provide a clear answer from the foundation to the argument of Wiki-PR that they did not engage in paid advocacy but only paid editing. The foundation is here acting as a defender of last instance against commercial forces, and they are backed by a majority of involved Wikipedians. This contradicts the earlier result of different views between the community and the foundation, when parts of the community wanted to be able to get paid for their editing, editing that they normally would argue was not paid ad-

[9]Although commonly referred to as “votes”, these decision-making processes are not strictly bound on a majority decision but on a discussion that “helps identify and build consensus” (Wikipedia contributors 2015a).

vocacy but in line with the guidelines and policies of Wikipedia. A preliminary analysis of that contrast suggests that the wage labourers of Wikimedia Foundation and Jimmy Wales do not have to think of the editing of Wikipedia as a way of earning money, and they can, therefore, function as a defender of last resort, more or less, in conflict with the material interests of the Wikipedians that have the opportunity of earning money from paid editing. We contend that the consensus reached regarding the question of the Terms of Use of the Wikimedia projects could be understood as an agreement reached over this conflict of material monetary interests between the foundation and the community. In the new consensus, Wikipedians who can get paid for their editing can continue with it if they are *open* about it, otherwise not. The bright line of Wales and the initial hard critique of the foundation, together with the rather strong community reaction against paid advocacy, led to this result, which is an example of the maturing of the project and a regulation of the relation to the capitalist economy that is thought to benefit the project as well as the Wikipedians living in capitalism.

It is possible to explain some of the fervour in the discussions around the change in Terms of Use that focused more on the paid editing than on the actual changes that only required disclosure and adherence to Wikipedia's policies as conflicting views on the social reproduction of Wikipedians in a capitalist society. Some annoyance is expressed by user Smallbones over the writings of the ed17 that is said to focus on what is negative with the changes in Terms of Use. User Coretheapple, who propagates clear disclosures to the readers, instead says that his interest in the question has been growing lately due to the "operatic expressions of fear and loathing that I've seen coming from the paid editing fan club. This indicates to me that there is genuine concern that the community may curb the practice effectively" (The ed17 2014b). This commsent can be seen as a sign of friction within the community – perhaps between those who have a paid job elsewhere and those trying to make a living as Wikipedians. In terms of the total social reproduction of Wikipedia, these positions point to very different perspectives: to the one that implicitly accepts Wikipedians' persistent dependence on paid labour performed outside of the sphere of the commons, thus maintaining a clear boundary and a "bright line" between the domains of work and leisure; and to the one that would not mind to see wage labour more integrated in the commons-based production system.

But the Swedish Wikipedia, for example, welcomes paid editors for much more practical reasons: the wellbeing of the encyclopaedia and its use value. According to *The Signpost*, a Swedish Wikipedian Anders Wennersten writes that paid editing is only a problem for the privileged English language version. As long as the paid advocacies play by the elementary rules, they are key stakeholders in helping Swedish Wikipedia to improve in value and quality. Also, the Norwegian Wikipedia is reported to contend that a straight ban on paid editors would be "wholly impractical" (The ed17 2014a).

Different Wikimedia projects have different needs. According to *The Signpost*, Wikimedia Commons is an example of a potential exception to the new rule. The project depends on high-quality photographs submitted by users who often receive compensation for them. The result of the extensive community discussion was the adoption of an opt-out clause that "allows WMF projects to adopt an *alternative disclosure policy* if there is clear community consensus for it" (The ed17 2014b).

The ed17 concludes: "The wide scope of this amendment will cover a large number of good-faith editors—but it also grants the WMF's legal team a weapon that they will selectively enforce against bad-faith actors, such as the former Wiki-PR" (The ed17 2014b). User Phoebe also makes clear in a comment to the article that you do not have to disclose anything if you are an expert in something or employed within a field: "It's only if you are directly employed to edit about your company, or a product, or what not." (The ed17 2014b)

In any case, the critique against paid editing *and* advocacy has provoked significant changes, including a regulation of praxis in relation to the capitalist system under the guidance of the Neutral Point of View (NPOV). A distinction is made between the regimes of the market economy and the economy of the common, while at the same time it is accepted that the reproduction of the Wikipedians as Wikipedians (in a capitalist world) is partially paid for by external and even commercial actors.

5. Rematerializing the P2P Debate

Wikipedia's relative financial independence is rendered possible by the relative economic strength of the donation-based funding model of Wikimedia Foundation. The financial model is a strong factor in what Lund (2015a) has called the *capitalism of communism*. What is important is the plenitude and heterogeneity of the donor base: the donations are many and small, but taken together, they contribute to Wikipedia's economic self-sufficiency, which is not too dependent on the interests of any specific actor. This gives some independence to the project in relation to individual capitals, but of course it indirectly rests on a dependency on capitalism as a system.

The breadth of the community base of mainly voluntary producing amateurs and the popular character of the donations overthrow some commonplace understandings regarding the division of labour and specialization. The notion of Marx that in the communist society no one should have an exclusive occupation but instead realize him/herself within whatever profession interests him/her, seems a bit less unrealistic with Wikipedia in mind. Exactly as when Marx talks of "well-rounded" and "complete individuals" in social association that is universal in character and transforms the productive activity into a self-activity that phases out the regime of private property, Wikipedia makes it possible to do one thing today and another tomorrow: "to hunt in the morning, fish in the afternoon, rear cattle in the evening, and criticise after dinner, just as I have a mind, without ever becoming hunter, fisherman, shepherd or critic" (Marx and Engels 1998, 53, 97). Wikipedia as a project is not dependent on individual persons, and the collaboration takes place in an *ad hoc* manner in relatively free digital networks (without forgetting that the digital divide and the global differences still play a crucial role) that enables the participants to scale up the production of use values because of the relatively cheap reproduction of digital files.

Sylvain Firer-Blaess and Christian Fuchs have put similar thoughts forward in an article that contends that Wikipedia has communistic potentials "antagonistically entangled into capitalist class relations" (Firer-Blaess and Fuchs 2014, 99). Our article makes a parallel contribution in examining *how* antagonistic the relation actually is, within which time horizon, and whether synergies and un-holy alliances with capital might also be important for the development of communism. Firer-Blaess and Fuchs are right in saying that Wikipedia with its practices and roots within what they call "info-communism" is introduced in the economic structures through a profit-driven infrastructure and the market for personal computers, through which a well-educated and global working class with enough leisure time and knowledge can make contributions to the real and not only the ideological realization of info-communism: "The free knowledge production by Wikipedians is a force that is embedded in capitalism, but to a certain degree transcends it at the same time. A new mode of production can develop within an old one" (Ibid). In their view, info-communism seems to mark a transition to a dominating communism pure and simple. This kind of communism is characterized by a level of high-technological productivity that enables a "post-scarcity society" which holds a promise of ending hard and alienated toil and yielding opportunities for creative work for all human beings (Firer-Blaess and Fuchs 2014, 90). In addition to this we just would like to point out the obvious that it was capitalism (or paid and exploited labour) which created the necessary conditions for Wikipedia, with its dependency on educated contributors with enough leisure time. Therefore alliances based on synergies between capitalism and Wikipedia could be necessary during a prolonged transition to potential communism.

Jakob Rigi maintains that the "logic of equivalents" is absent from peer production and does not see any form of on-going classic gift economy in it. He comes to that conclusion from an analysis of the formal rules of some projects and a rather constricted theoretical definition of gift economies (Rigi 2013, 397–398, 400, 403). Instead of a gift economy based on the logic of reciprocity, Rigi sees peer production as a forerunner of communism. Peer production negates alienation by bypassing the division of labour and substituting a "joyful and creative productive activity" for labour. This new way of producing differs from "the common" of Hardt and Negri, which is ubiquitously present in society (Hardt and Negri 2009). Peer production appears as *islands* within capitalist social formation, and its generalisation will

require a social revolution (Rigi 2013, 4). But before that, the mode of production does not exclude commercial activities from attaching themselves to (mostly) the margins of the projects in the form of services and material products derived from them (Gye 2007a; Bauwens 2009). While these lines of reasoning are somewhat vulnerable to the aforementioned "ideology of digitalism" (Pasquinelli 2008, 72–90), they also reveal pathways for a real emancipatory potential.

Carlo Vercellone (2007; 2010) has stressed the increasing importance of rent-based profits in today's capitalism. If that holds true, the exploitation due to user activities on commercial and digital platforms, as well as the increasing importance of the peer production of use values within capitalism, intensifies on a systemic level and in other sectors and parts of the capitalist world system (Caffentzis 2013). This calls for the key importance of connecting the privileged peer production with social movements in the global South.

Moreover, peer production is no more confined to the immaterial or intangible part of the economy, as it has spread to sectors of citizen journalism, open data and open design. Discussions about how to migrate the peer production model to tangibly material production have picked up steam with the development of 3D printers and Fab Labs (Siefkes 2012; Anderson 2012; Maxigas 2012). Crowdfunding and alternative currencies have become important in this context, with their own strengths and weaknesses. For example, Tiziana Terranova and Andrea Fumagalli (2015) have recently examined a crypto currency, Commoncoin, which would be developed into a kind of "money of the common". They maintain that the capability of finance to express the value of such cooperation through a form of money which is not simply exchangeable into commodities but which has the power to shape the future(s) is a crucial stake in new forms of struggle (Ibid 151–152).

For Wikipedia, crowdfunding would probably be a more attainable route towards the "commonification" of the material conditions of immaterial knowledge production. Inge Ejbye Sørensen points out Kickstarter as a pioneer in this field around 2009, but Wikipedia had already been gathering donations for some time by then. He concludes that there are 95 different crowdfunding sites in the UK today that are supporting various projects and start-ups (Ejbye Sørensen 2015, 269). Crowdfunding has different faces: it could refer to donations, rewards, pledging, peer lending, patronage, or be based on royalties or equities (Ejbye Sørensen 2015, 269; Ridgway 2015, 283–287). Ejbye Sørensen stresses the importance of monitoring the working conditions in these projects as well as how the quality of production complies with professional standards (Ejbye Sørensen 2015, 279; cf. Duguid 2006). In contrast, Renée Ridgway contends that crowdfunding can go in different political directions. In a neoliberal version, it can lead to cuts from in the public expenditure—Kickstarter contributed more with its micro-donations to the relevant fields in 2013 than National Endowments of the Arts in USA. The Spanish project Goteo points in another direction. It is a social network for collective financing built on monetary and non-monetary contributions. The project is focused on building support for the commons (Ridgway 2015, 282–283). Wikipedia, then, has to address these socio-economic and political questions so that it contributes on an overall level to the strengthening of the commons instead of neoliberal state reforms and deepening exploitation.

These examples of a latent stream of capitalism of communism (which is slowly outcompeting rather than using the class struggle against capitalism) portray a principally emancipatory force that has some serious obstacles ahead of it, but it can be made more sustainable through the inclusion of a anti-capitalist critique of the ideological formations that Lund (2015a) identifies in the Swedish Wikipedia.

Different and conflicting ideologies exist in the Swedish project regarding wage labour within the editing process in the hands of Wikimedia Foundation, as well as financed by external actors. Paradoxically, on the surface of things, wage labour in the hands of the non-profit foundation is perceived as more dangerous for the project if applied within editing, than if the paid editing is externally financed in the form of Wikipedians in Residence within external actors. External commercial actors are not seen as dangerously powerful when it comes to the actual activity of peer production. And feelings of injustice are not being triggered when the wages come from somewhere else (Lund 2015a; 2015b).

On an ideological level the Wikipedians, according to Lund's study, seem to be in favour of wage labour within Wikipedia, but to various degrees and often with qualifications. The contributors stress the need for wage labour when it comes to certain tasks outside of the editing process. Some of them have a narrower view about this "commercial outside" to peer production than others. The non-commerciality of the WMF is sometimes expressed as a reason for this acceptance. An identified ideological formation named *the peripheral* within the Swedish Wikipedian community is sceptical to wage labour in the hands of the foundation in the editing. This formation is rather informal and playful in character. Another identified ideological formation, *the bottom-up formation*, shares this view, but they are more in favour of the ongoing professional focus within Wikipedia on improving the quality of the encyclopaedia according to abstract standards than the peripheral formation is. This ideological formation explicitly positions itself against wage labour in the hands of WMF within the editing process as something that risks impairing peer production. On the other hand, there is also an ideological *top-down formation*. This formation does not see any problems with the foundation using their wage labour in the editing process. According to them, there is no consensus against this practice, and there is not even a problem, because it will not happen as it is not effectively used money for the foundation (Lund 2015a; 2015b).

The three identified ideological formations, the peripheral, bottom-up and top-down, show that the support for some wage labour within the project is not unqualified. Two out of three formations want to keep wages paid by the foundation outside of editing. These ideological formations are the ones that need to be supported in a way that helps Wikipedia to enter into empowering alliances with capitalist companies as well as other institutions.

A business-friendly standpoint has to be checked and counteracted by a revitalized theory that critically examines the peer production projects' alliances with capital. Not all alliances with the other mode of production (capitalism) benefit Wikipedia or other voluntary projects. Such a critical perspective is urgently needed: on a macro level Lund's study concludes that the Swedish Wikipedia is dominated by ideological formations that stress the non-friction or non-importance of the friction between peer production and capitalism (Lund 2015a), and the future will hopefully see some attempts at formulating a critique against these formations

6. Conclusions

This article has elaborated on the materialities of commons-based peer production by examining the lines of conflict occurring around the economic relations of Wikipedia, and particularly with regard to its relation to increasing commercial pressures.

We began by stating our view that an understanding of the social collaboration upon the digital commons as "immaterial"' is one of the persistent problems in the commons debate, and that this conception should be deconstructed and replaced by a more detailed analysis of the different material layers required to sustain the production. But similarly, any understanding of immaterial commoning solely through the looking glass of its environmental impacts would be an underestimation of its potentials. We proposed that the analysis of *monetary materialities* should include the inputs that are required to sustain the operations of the commons system, but also, by extension, the ones that sustain the lives of the commoners themselves. In this context, we sought to problematize and cross-examine the issues of paid editing and paid advocacy by analysing the debates within the community after the revealing of the Wiki-PR scandal in 2013. In our analysis, we focused on the revision of the Terms of Use for all of the Wikimedia Foundation's projects, a measure that took place after the three community-led policy proposals to regulate paid advocacy had failed due to the lack of any consensus.

In comparison to other notable examples of peer production (such as GNU/Linux), we concluded that Wikipedia is marked by its strong aversion towards money and its endorsement of the use of unpaid work to produce the desired end product, the common encyclopaedia of knowledge. At the same time, Wikipedia is technologically dependent on assets that cannot be acquired or maintained without money. These assets include the technical equipment, such as the data centres, but also and most importantly the unpaid contributions

from the voluntary editors. The editing community is understood as the actual core of Wikipedia, whereas Wikimedia Foundation is seen as a backdrop, technological provider and media representative, working behind the scenes of the actual processes of peer production. However, most of the money-related activities are also managed within the foundation, which increases its institutional power within and in relation to the volunteering community. Wikipedia's hybrid economy—with the centralized monetary technological assets, on the one hand, and the decentralized, commons-based knowledge production, on the other hand—is prone to political tensions, which however are foregrounded only in exceptional circumstances.

The Wiki-PR affair and its resonances teach us an important lesson about how Wikipedia (as a community of commoners) and Wikimedia Foundation handle the materialities of their projects. First of all, there seems to exist, as Osman (2014) rightly points out, a notable share of Wikipedians in favour of paid editing within the scheme of commons-based peer production. The problem with Osman's analysis is that he regards this as a new situation, implying that Wikipedia was less commercially dependent before. In our understanding, this is not the case: there has never been an era of a paradise, but rather a continuous process of self-transformation.

As Sue Gardner, executive director of the Wikimedia Foundation from 2007 to 2014, admits in her press statement (2013), the discussion on paid editing has been "a divisive topic inside Wikipedia for many years". Wikipedia was initially established and owned by a private company Bomis, but later was passed on to a non-commercial foundation. This foundation has now, due to the Wiki-PR affair, sharpened the terms of use so that for the time being, paid editing is condemned whenever it takes a hidden and unregulated form, while paid advocacy is always plain wrong and against guidelines and policies. The solution leaves some flexibility for special circumstances and alternative policies in specific projects if the concerned community wants to pursue them.

In the debates in Wikipedia's community journal, *The Signpost*, the German Wikipedia is mentioned as an example to follow. Wikipedia should take the "bull by the horns, as the German WP has done", user Tony states. "I believe de.WP has about 500 such accounts, and they are watched wherever they go. It's not ideal, but it's more practical than what we have now". Tony gets the support of user ¾-10 who concludes: "I believe that's where the future ought to lie for all WPs, regarding this topic", and user Chris.urs-o: "I agree. Good faith editing should be separated from propaganda lies" (The ed17 and Jayen466 2013). It could be argued that the amendment of the Terms of Use that was crafted shortly thereafter was a first step in this process.

The role of Wikipedia's founding figure, Jimmy Wales, in the debates is interesting. The actions of the foundation in sharpening the terms of use to defend the reliability and independence of the project are rather moderate in expression, whereas Wales talks of a "bright line" that should not be crossed when it comes to paid editing. This standpoint is annoying to some Wikipedians. User Tony states: "I'm uncomfortable with Jimbo's anti-paid-editing line: it's just unrealistic, even though I'd sooner have zero tolerance for PE [paid editing] on foundation sites if we *could* identify PE" (Gnom et al. 2012).

Wales behaves, in our view, as a kind of defensive *libero* in a rather iconoclastic and elevated way. He is and should be pure so that the project does not lose its voluntary and non-commercial character. The foundation, however, takes a middle position that is more practical but still more principled than those of many Wikipedians, especially in small-language versions, that are engaged in practical editing. These commoners are the ones that could face problems in finding a way to reproduce themselves as Wikipedians in a capitalist world, and therefore maybe it is not so surprising that they are more in favour of paid editing than Wales and the foundation, even if there are conflicting views on this in the community. The debate between these Wikipedians and user Coretheapple who calls them a "paid editing fan club" is rather an example of a heightened political discussion within the project than a declining one, as Osman seems to portray it.

All in all, we are witnessing increasing attempts to contain and control the commercial influence on Wikipedia and to direct business activities to the advantage of the project. This is not a sign of a less radical community within the peer production, but rather an example of a

capitalism of the commons (Bauwens and Kostakis 2014, 356–361), or as we put it, a capitalism of communism.

For this ideological current to survive and prosper it should be informed by more critical perspectives against paid editing, wage labour in general, and continuously increased fundraising. Dimitry Kleiner's (2010) concept of *venture communes* could be an inspiration for discussions of reforms of the foundations and its local chapters' character, in more decentralized ways. Also, Bauwens' elaboration (2012) on Kleiner's Peer Production License (2010) could show the way if the project's alliances with capital and companies become problematic.

For now, it seems more progressive to make these alliances in the current manner under a copyleft license, but this could change quickly. From academia, especially critical theory has the responsibility to help these germs of a new mode of production to grow stronger while still pointing outside the confines of capitalism.

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Beyond the Screen: Uneven Geographies, Digital Labour, and the City of Cognitive-Cultural Capitalism

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Abstract: In this paper, we demonstrate that an examination of the socio-environmental impacts of digital Information and Communication Technologies (ICTs) remains a fruitless enterprise without "materializing" digital labour. We suggest a two-part approach to materializing digital labour: first, connecting political economic analyses of digital ICTs to the co-evolution and geography of planetary urbanization and technological change, and second, examining the relationships between immaterial, digital labour and the material industrial production system. In the context of broad changes in technology, social life, and urbanization, many scholars have theorized a shift towards a third phase of capitalism, beyond mercantilism and industrialism, based in immaterial, digital, and cognitive labour. We introduce the literature on cognitive-cultural capitalism and third-wave urbanization as markers of contemporary capitalism, producing uneven socio-spatial arrangements across the global-urban system. Synthesis of media and communication studies and political economies of urbanization suggests that both capital accumulation and the social lives of (planetary) urban residents are increasingly mediated and structured by online, digital ICT platforms. We show that digital ICTs are sophisticated manipulations of nature that require and illuminate new ways of thinking about digital labour, and more broadly, of immaterial labour. We suggest that the immaterial labour associated with digital ICTs is actually material labour responsible for increasing the velocity of capital circulation, as a moment of production and an appendage of the growing complexity of third-phase capitalist industry and urbanization. The materiality of cognitive, cultural, and symbolic labour reaches beyond the city, invades the lifeworlds of a planet of urban residents, and excretes concrete, silicon, bits, servers, and energy waste producing an urban landscape beyond the city. Through an examination of data centres, we show the necessary relationship between the third-wave urbanization and its planetary reach into rural, pristine Oregon. Data centres in Oregon and the broader Pacific Northwest highlight the uneven geography of "clean" digital labour focused in large urban technopoles; the potentially harmful, material, and socio-environmental impacts of data centres in rural areas; and the necessary and dialectic relationship between the two for cognitive-cultural capitalism. We argue that third-wave urbanization, and the concurrent and co-produced technological advancement in digital ICTs and digital ICT infrastructure, creates the conditions for capital's subsumption of cognitive and cultural labour.

Keywords: digital labour, cognitive-cultural capitalism, circulation, third-wave urbanization, urban political ecology, digital ICT infrastructure, data centres

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1. Introduction: Social, Economic, and Technological Transformations

> All that is solid melts into tweets (Wyly 2013, 391).
>
> Society has completely urbanized (Lefebvre 1992, 1 [1970]).

In the "phantasmagorical" contemporary networked city, technological networks are interlinked in an integrated "machinic complex" of speed, light, and power (Amin and Thrift 2002). Information and communication technologies (ICTs) have co-evolved with cities, enabling ever more seamless integration and ubiquity in the urban fabric (Graham and Marvin 2001;

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Sussman 1999). Undergirding and co-shaping spatial, social, and political-economic transformations have been the development of *digital* ICTs, the internet, and web-based platforms for social media. The social lives of urban residents have increasingly taken place on social media sites, structured by capitalist business platforms such as Facebook (Zip, Parker, and Wyly 2013). Castell's (1996) space of flows and space of places are in a dialectical tension, caught up in the mix of twinned processes of technological change and urbanization as both urbanism and Facebook become a way of life.[1]

The broad changes in technology, social life, and urbanization have led many scholars to theorize a shift towards a third phase of capitalism, beyond mercantilism and industrialism, based in immaterial, digital, and cognitive labour. Cognitive capitalism, as Autonomist Marxists and others call it (cf Peters and Bulut 2011), is marked by an accumulation process centred on immaterial inputs, immaterial and digital labour processes, and production of immaterial goods such as services, cultural products, knowledge or communication (Peters and Bulut 2011; Hardt and Negri 2004). Scholarship both within urban and economic geography and media and communication studies have questioned the implications of this third phase of capitalism, or "cognitive cultural capitalism" (Scott 2009; Scott 2014), particularly in relationship to questions of space, place, time, and the division of labour. The overwhelming focus on the *immaterial* aspects of cognitive-cultural capitalism, however, obfuscates the *materiality* and socio-environmental foundations of capital accumulation and circulation. Today's technological circumstances further complicate analysis on capital, labour, production, and circulation because of the continued changing nature of goods:

> A good deal of confusion has arisen over the changing physical nature of goods... This derives in part from increasingly *sophisticated manipulations of nature* involved in modern production, particularly via electronics. Many people have antiquated notions of goods derived from the mechanical age. They fail to see that a computer program, which takes the form of electrons on a tape or disk, is every bit as much material good as a chair. It was produced by labor, it has continuing existence, and it performs a useful function. It has a discrete and tangible form, unlike a true labor-service. The real distinction here is between tactile and non-tactile goods, or things that are easily seen and grasped and those that are not (Walker 1985, 50–51, emphasis added).

One of our main contentions is that digital ICTs are "sophisticated manipulations of nature", bringing new light to notions of digital and immaterial labour. We suggest that the immaterial labour associated with digital ICTs is actually material labour involved in increasing the circulation velocity (or rate) of capital. That is, digital labour uses digital ICTs and builds on existing material infrastructures to increase the speed that capitalists realize profit. Cognitive labour and the immense network of fixed capital infrastructures that support it are an appendage of the growing networks of third-phase capitalist industry and urbanization. Digital ICTs and digital infrastructures, as Walker suggests, are "the things that are not easily seen and grasped." Therefore, an unearthing of infrastructures of digital ICTs, especially those beyond the screen, is an essential task for understanding the socio-environmental impacts of digital ICTs.

In this article, we highlight how socio-material processes and circulations of capital produce uneven geographies. We utilize the framework of urban political ecology (UPE) to trace how planetary urbanization under cognitive-cultural capitalism (CCC), or "third-wave urbanization" (Scott 2009; Scott 2014), mandates new forms and physical expressions of the circulation of capital. Landmark work in UPE has focused primarily on water infrastructure (cf Swyngedouw, Kaika, and Castro 2002; Swyngedouw 2009; Loftus 2012) or urban trees (Heynen, Perkins, and Roy 2006), but the technological realms of energy, communication, and information infrastructure are largely unaddressed. Existing studies have focused on political ecologies within the city and less so on the socio-ecological processes which pro-

[1] This refers to Louis Wirth's (1938) seminal paper, "Urbanism as a way of life", originally published in *The American Journal of Sociology*. His contribution was extended by Zip et al (2013) in their formulation as "Facebook as a way of life" describing the contemporary networked relations of an increasingly urban world.

duce the city and the configurations of city networks that are both manifestations of capital circulation and means for further capital accumulation. As Angelo & Waschmuth argue, "urban political ecology (UPE) has done an exemplary job of investigating environmental questions in cities, [but] it has been curiously quiet on the very feature of the contemporary urban world that should make it so relevant: the dimensions of urbanization processes that exceed the confines of the traditional city" (2014, 2). Our study responds to Angelo & Waschmuth's critique through examination of data centres in rural Oregon, a critical infrastructure of third-wave urbanization and digital labour. Cities of cognitive-cultural capitalism are reliant on these energy-intensive data infrastructures to facilitate digitally-enabled cognitive and cultural industries, creating and reproducing a new division of labour that (re)inscribes social disparities in the uneven geographies of the city and landscapes beyond.

2. Third-Wave Urbanization

To examine the socio-environmental impacts of digital labour requires an interrogation of how digital labour is distributed and divided in space. We add a geographical dimension to the political economy of digital labour by connected digital labour to the social, technical and capitalist process of urbanization. The study of urbanization, as a process, mandates a focus on the networked, spatialized and digital aspects of capitalism's contemporary phase, cognitive-cultural capitalism. Following urban geographer and political-economist Allen J. Scott, we use the notion of CCC to synthesize the heterodox evolution of two strains of thought. Firstly, we take concepts like post-Fordism, flexible accumulation, and flexible specialization from the studies on labour and industry to analyse the capitalist changes in industrial organization since the 1970s (Bluestone and Harrison 1982; Harrison and Bluestone 1985; Scott 1986; Piore and Sabel 1986; Storper and Walker 1989; Amin 1994; Massey 1995; Markusen and Schrock 2006). Secondly, we take concepts of cognitive-capitalism (sans cultural) which stress the dialectic relationship in the production processes between capital and labour amidst structural changes to suggest a new form of subsumption (of social reproduction, culture, knowledge) (Vercellone 2007; Terranova 2000; Scholz 2012; Moulier-Boutang 2012). Each attempts to describe a different facet of the uneven and broad changes associated with the intensification of production and the fungibility of both capital and labour made possible by technological advancement, spatial reorganization and new forms of cognitive labour. As a historical moment of capitalism, we can integrate these two literatures and characterize CCC with three central markers:

> (1) the new forces of production that reside in digital technologies of computing and communication; (2) the new divisions of labour that are appearing in the detailed organization of production and in related processes of social re-stratification, and (3) the intensifying role of mental and affective human assets (alternatively, cognition and culture) in the commodity production system at large (Scott 2011b, 846).

Scott's empirical observations and theorizations support the notion that the cognitive-cultural system of production is transforming the economic foundations of urban regions worldwide. More specifically, these inter-related markers taken from Scott's work describe the crucial components of CCC that relate specifically to digital labour.

First, calculation, communication and information storage are performed using digital methods. Digital methods reduce the costs of transportation and storage while also reducing the time necessary for communication. For the capitalist, this has significant impacts for command and control operations, changing the nature of production and organization. Second, urbanization processes include new divisions of labour with implications for the re-stratification of urban labour and social life. Scott defines this division between two distinct classes: highly qualified symbolic analysts, and a low-wage service underclass or a new servile class (2011). The former perform functions using knowledge, cognition and symbols (cognitive-cultural workers) while the latter perform service functions as either manual labour or menial service labour. Lastly, these productive changes are also reflected in consumption. Consumers spend larger shares of their income on large and varying palette of

goods and services that have potent experiential significance. Furthermore, the social, economic, and technological changes characteristic of cognitive-cultural capitalism shape, and are shaped, by the built environment of the city. These changes are characterized by new and altered land uses and an "aestheticized land-use intensification." The result is the production of spectacular architectural gestures that "world" cities and serve largely as monuments to transnational corporate power (Scott 2011b).

A basic understanding underlies this point: capitalist urbanization is a socio-spatial process resulting in spaces of intensified economic activity, and as such, is represented by agglomerations of capital and labour. Cities are densities of production and social reproduction necessary for capitalism's own reproduction. Contemporary cities of CCC can be recognized by their predominance in the digital, cultural, or informational economy, or as Scott calls them, "cynosures of the so-called 'new' economy" (2011a, 290), and furthermore, by their functional character as key nodes in global relationships of the networked urban society.

In other words, cities are socio-material spaces that are shaped and reshaped for capital accumulation. Of course, this is not to diminish other powerful forces that shape cities and their growth or decline, but instead, to show that CCC has developed, and is developing, alongside technological advancement, market extension and globalization (Scott 2011a). Here, again, the role of digital ICTs are important. For example, Zip, Parker and Wyly note that national rates of urbanization are correlated with national rates of market penetration for Facebook (2013).

> [The] occurrence of two historically unprecedented phenomena: a majority-urban world, and a world where billions of people can and do regularly engage in social relations through dynamic networks transcending geographical proximity. As the world has become 'urban,' social media has transformed key facets of urban social relations while also diffusing them across suburban and rural areas (Zip, Parker, and Wyly 2013, 84).

This should be no surprise. Technology is co-evolving with planetary urbanization (Wyly 2013). Dialectically related to the historical development of capitalism, cities are outcomes of larger urbanization processes that reflect the dominant mode of production and system of socio-metabolic organization, or capitalism.

2.1. Planetary Urbanization, Circuits, and the Circulation of Capital

Scott's notion of the third-phase of capitalism can be counterpoised against the work of marxian social theorist Henri Lefebvre. Lefebvre posited that urbanization is the dominant form of capital accumulation, supplanting industrialization as the motor of capital accumulation (2003 [1970]). David Harvey argued, conversely, that the city was shaped by industrial capitalism, i.e. industry created the conditions for urbanization, and this was especially apparent in the circulation of surplus value produced by capital accumulation. We see both of these processes concurrently. The spatial organization of capitalist urbanization is marked by unevenness, with booming edges marked by suburban development, industry, and slums and favelas while the urban centres are simultaneously undergoing rapid gentrification. Industrial expansion tends to lead to a regional convergence in capital legibility, increased capital mobility and spatial differentiation foster continued unevenness (Walker 1978). Highly mobile global capital descends on urban centres, inscribing and re-inscribing the logics of capital accumulation in the urban landscape (Smith 2005). Urbanization may not be the dominant regime of capital accumulation, but it is certainly planetary in both scale and reach.

The recent explosion of research into planetary urbanization supports and expands Lefebvre's argument (Brenner and Schmid 2014; Brenner and Schmid 2015; Brenner 2013; Merrifield 2012; Merrifield 2013a; Merrifield 2013b). Lefebvre was concerned with the "complete urbanization of society", and not "urban society", because he wanted to transgress the infatuation of studies on the object of the city. In *The Urban Revolution*, Lefebvre sought to study the urban fabric—a virtual and theoretical object that embodies the notion that city

has dominated the countryside (and everything else) in social, mental, and physical space – which mandated the study of *the urban,* not the city. Lefebvre's thesis necessitated a conceptualization of how capital shapes not only the urban landscape, but also the concepts and categories of space and time. As Andy Merrifield (2013b, 913) argues, Lefebvre did this to show how the urban is a concrete abstraction – an actual reality and a concept of reality. We argue for a connection between Lefebvre's theory and David Harvey's work on 'the urbanization of capital' (Harvey 1981; Harvey 1989), which shows how capital flows through at least three circuits: primary, secondary and tertiary. The primary circuit relates to investment in commodity production, but often confronts the crisis of overaccumulation necessitating a "capital switch" to the secondary circuit (Christophers 2011). The secondary circuit relates to investment in fixed capital (factories, machinery, technologies, and the *built environment for production*, e.g. roads, rail, infrastructures) or a consumption fund (commodities that aid in consumption or the *built environment for consumption*). The tertiary circuit is an overflow container for overaccumulation in the secondary circuit. It includes investments in science and technology, and social expenditures that enhance labour's productivity or reduces social anguish and strife to secure consensus with labour.

Building on Merrifield's interpretations, we can explain Lefebvre's thesis in relation to the secondary circuit of capital. As Merrifield notes:

> Flows of investment that produce space, that seemingly have the same vital, spontaneous energy of a Pollock loop, power the 'secondary circuit' of capital into real estate, a circuit of investment that formerly ran parallel to the 'primary circuit' of capital, to industrial production, but which now, Lefebvre says, has grown to be relatively more important in the overall global economy (2013b, 914–915).

Engaging with the Lefebvrian notion of planetary urbanization, Harvey (2014) more recently has suggested that capital cannot exist without the processes of urbanization. He, as in earlier work, claims urbanization is absolutely "vital to the reproduction of capital accumulation and the reproduction of the power of the capitalist class" (2014). The boom in urbanization is entirely about "absorbing surplus capital, sustaining profit levels, and maximizing the return on exchange values no matter what the use value demands might be," creating the conditions for the crisis of planetary urbanization.

In Lefebvre's thesis of planetary urbanization, the secondary circuit predominates while the primary circuit dwindles away, impacting labour, as a condition of post-employment emerges. Lefebvre, explained that on the one hand, information technology and automation facilitate, mature, and expand the urban toward planetary dominance. On the other hand, information technology and automation mean that "post-employment ensues, coupled with more planetary urbanization, and more industrial contradictions that now somehow manifest themselves as global-urban contradictions" (Merrifield 2013a, 21). Unemployment, or at least unsalaried/waged work, is "structurally inseparable" (2013a, 21) from the dynamic of accumulation and expansion—urbanization on a planetary scale for Lefebvre – which constitutes the very nature of capitalism as such (Merrifield 2013a; Merrifield 2012).

In conjunction with what Merrifield calls the urbanization of the general intellect, we take this point to clarify the relationship of urbanization with immaterial and digital labour, but we problematize the claim that immaterial labour will be the demise of capitalism in the long run. Instead, we see immaterial labour as dialectically related to material labour. We discuss this further in the next section, referencing Fuchs (2014) work on the international divisions of digital labour, but want to highlight here that as immaterial labour grows, replaces and distances or peripheralizes material labour, the secondary circuit of capital takes on a greater role. Fixed capital, or dead labour, replaces living labour:

> When the world of work is dominated by machines, when we become appendages to machines, to new technology, to informational digitized technology, when technology "suspends" human beings from "the immediate form" of work, when dead labor valorizes living labor, then and seemingly only then are we on the brink of something new and possible (Merrifield 2013a, 23).

The focus on immaterial and digital labour associated with a third phase of capitalism—cognitive, cognitive-culture, informational, global-informational, informational-transnational, etc.—and its relationship and co-evolution with urbanization processes indicates that scholars must consider the geographies of digital labour and include analyses of urbanization in relation to capital accumulation and circulation.

We support Harvey's focus on urbanization as the physical and material excrescence of the circulation of capital, but suggest, in the vein of planetary urbanization, that this be expanded to include infrastructures vital to urbanization processes beyond the territory of the city as politically defined. Urbanization crosses political boundaries and regional identities, reaching globally, connecting people and industries separated by great distances. Following the infrastructures of digital ICTs can illustrate how urbanization, and its vital connection to the *circulation* of capital, reaches beyond the bounds of the city, aiding the increasingly immaterial forms of labour associated with planetary urbanization and cognitive-cultural production. As Marx and Engels explain in *The German Ideology*, "The greatest division of material and mental labor is the separation of town and country" (Marx and Engels 1978), but the materiality of "mental labour"—or cognitive and cultural labour—reaches beyond the city, invades the lifeworlds of a planet of urban residents, and excretes concrete, silicon, bits, servers, and energy waste producing an 'urban landscape' beyond the city.

2.2. The City of CCC and Digital Labour: A Global Audience Commodity

Scott's analysis of third-wave urbanization focuses on cities with a predominant cognitive-cultural economy. Critics warn that such a focus might privilege theorization towards a smaller applicable population of urban inhabitants leading to a "telescopic view of the city" (Meagher 2013). However, Scott develops a framework for understanding contemporary, emergent patterns of urbanization that, as Wyly (2013) notes, can propel a radical political agenda that recognizes social knowledge as a direct force of production with socio-spatial impacts. We find Wyly's more critical analysis of CCC, which takes planetary urbanization and technological change in a co-evolutionary perspective, to be a fitting extension of Scott's work with the Marxian political economic analyses of media and communication studies. The co-evolution of technological innovation and urbanization "is an essential feature of cognitive-cultural capitalism" (Wyly 2013, 389). For Wyly, this co-evolution of technology and urbanization serves to increase the velocity of consumption. Wyly's formulation of the city of CCC critiques the "shitty positivism" of "the new social physics" emerging in the "neoliberal noosphere" where

> […] billions of smartphones, RFID (radio frequency identification) chips and QR (Quick Response) codes, and trillions of social-media data trails on preferences and purchases of physical commodities, services and media content. Data flood in, and the pattern-recognition algorithms optimize and monetize attention, creativity and communication amidst the neoliberal wind that capitalizes, commodifies, classes, and marketizes everything. Social reality is ransacked, but not for theory: click-throughs, page views, eyeballs and ad revenue are what matter (2013, 392).

For Wyly, the attention spans of users are the raw materials for production of informational and advertising industries. Connecting Wyly's provocations with Smythe's "audience commodity" and broader discussions on digital labour, we suggest the urban becomes a central concern. The prosumer commodity, as in relation to Dallas Smythe's "audience commodity," elaborated by Fuchs (2012c) and others, refers to the exploitation of labor (surplus value creation) through processes of coercion, alienation, and appropriation enabled by digital technology and the harvesting of personal data. Fuchs discusses this process in terms of "Google Capitalism" (Fuchs 2012a), whereby surveillance is invested in the circuit of capital accumulation, and the Internet prosumer is both commodity and commodifier—as identity and consciousness are mined for data ("extracted knowledge") as a "natural" online digital resource in the formation of the advertisement commodity. As audiences produce data and consume ads specifically targeted to them, the urban is shaped to aid in this mode of production and in the circulation of capital. The global attention span, is an *urban* global audience

commodity, packaged and sold as a prosumer commodity to the world's largest advertising companies, Google and Facebook. Third-wave urbanization under CCC transmits the digital labour of producers and prosumers into a planetary material force.

3. Sites of Digital Labour and Value Production

3.1. Digital Labour "Beyond" the Screen

In light of the growing scholarship on digital ICTs and digital labour (Hermann 2009; Arvidsson and Colleoni 2012; Andrejevic 2012; Fuchs and Sevignani 2013; Fuchs 2014; Mosco 2014; Qiu, Gregg, and Crawford 2014; Comor 2015; Rigi and Prey 2015), we point to the focus on immaterial and digital labour at the beginning of the production process and caution against a potentially telescopic view of labour. The growing forms of exploited and mechanized immaterial and digital labour in the full cycle of capital accumulation, particularly in capital circulation and urbanization, needs further explanation. In particular, theorizations about the connection between digital labour and cycles of capital accumulation have incited disagreement and confusion. In this on-going discussion scholars tend to focus on labour and production—generally the interaction between user or worker (of whatever type) and the digital device (its use or creation)—and fail to examine the larger process of surplus value creation, realization, and critically, circulation. This tendency renders digital labour as placeless and (in most cases) immaterial.

Research at the intersection of digital media and digital labour borrow the idea of immaterial labour from the tradition of autonomist Marxists. The immaterial form of labour is at the core of cognitive capitalism (Hardt and Negri 2004). Immaterial labour takes the form of services in mechanized manufacturing, cognitive "analytical and symbolic tasks", and the "production and manipulation of affect" (Hardt and Negri 2004, 293). While the main claim of theorists in this tradition is that a "new accumulation regime based on immaterial assets constitutes a new phase of capitalism" based on "intellectual, immaterial and digital" labour that are made possible from new technology, primarily digital communication technologies, that no longer depend on raw materials but on cognition, intellect and knowledge (Peters and Bulut 2011, xxxi).

Despite foundational work by Dallas Smythe calling to examine the materiality of communication technologies[2] (1981), this contrast confuses the examination of the (socio-)material aspects of digital labour, digital ICT devices and digital ICT infrastructure. Research on digital media and technologies, and the internet more broadly, however, has recently taken a renewed interest in materiality and specifically Marx (Eagleton 2011; Fuchs 2012b). Fuchs and Sevignani (2013), Fuchs (2014), Fuchs and Sandoval (2014), and Qiu, Gregg and Crawford (2014) examined several cases of digital labour highlighting socio-material considerations – mineral extraction under slave-like conditions in the Democratic Republic of Congo, manufacturing and assembly of digital technologies in China at Foxconn, software engineering in India and Silicon Valley, and prosumption by internet users. While these studies consider materiality by examining the various forms of digital labour, their discussion on the broader social, spatial and environmental impacts is limited.

The focus on "the screen"—a phone, tablet, or computer or other digital ICT device – has allowed scholars to link the interaction between users and the screen into their study of the relations of production of the digital ICT device with which the user interacts (Qiu, Gregg, and Crawford 2014; Fuchs and Sandoval 2014). This examination of the production of digital ICT devices opens up many sites involved in the "international division of digital labour" (Fuchs 2014) like the Foxconn plants in China where Apple iPhones are produced. In relation to the broader literature on materiality (outside of media and communication studies, in geography and UPE), scholarship on the political economy of media and communication contributes to an understanding of the social relations of digital labour at the site of production and consumption. However, it misses the socio-environmental impacts of

[2] Also noted by Fuchs (2012c, 694–695).

the digital ICT device over its entire life-cycle—from production to disposal—*and of the fixed capital infrastructure that enables the networked connectivity vital to user-screen interactions*. The perception of "immaterial" labour as operating within the confines of a user-screen interaction obfuscates the larger physical infrastructures and spaces of digital ICTs that have coevolved with the cognitive-cultural economy and the contemporary networked city.

Referring to the specific case of the internet, Terranova explains that "[far] from being unreal, empty space, the internet is animated by cultural and technical labour through a continuous production of value that is completely immanent to the flows of the network society at large" (2000, 33–34). The digital economy, in this case, similar to Scott's cognitive-cultural economy, is a mixture of cultural economy and the information industry, and "an important area of [capitalist] experimentation with value and free cultural/affective labour" through "specific forms of production (web design, multimedia production, digital services, and so on), but it is also about forms of labour we do not immediately recognize as such: chat, real-life stories, mailing list, amateur newsletters, and so on" (2000, 38). Terranova's notion of free labour points the "immanent process of *channelling* collective labour (as cultural labour – digital or immaterial) into monetary flows and its *structuration* within capitalist business practices" (39, emphasis added). Recent work by Cockayne shows how labour value, social values, and the affective attachments of digital media workers in San Francisco are structured, embedded, and transmitted through "hegemonic and seductive entrepreneurial working practices" (forthcoming); both shaping, and shaped by, San Francisco's urbanization, technical infrastructure, and their respective planetary reaches. In this paper, we argue that processes of channelling and structuration of labour is shaped, in part, by the socio-metabolic processes of capitalist urbanization coevolving with capitalist technological development. As such, the question of immaterial, digital, labour becomes not about the actions of users at their devices, but of the mode and social relations of production. Specifically, the moment of production of circulation that is facilitated by fixed capital infrastructures.

The type of immaterial labour discussed by Terranova (2000) and by Lazzarato (1996), for example, is seemingly in stark contrast to the formations of labour which rely on a direct interaction between man and "external" nature.

> Labour is, first of all, a process between man and nature, a process by which man, through his own actions, mediates, regulates, and controls the metabolism between himself and nature. […] Through this movement he acts upon external nature and changes it, and in this way he simultaneously changes his own nature […] (Marx 1992, 283, 290).

Marx's oft cited formulation of labour is but one moment in the productive cycle. Labour represents the conversion of money to commodity, but there is still conversion of commodity back to money. Marx is, however, only giving one example of production here and in his own formulation of the circulation of capital, as discussed in Volume 2 of *Capital*, the metamorphoses of quantities of value, between M, C, and M', play crucial parts.

> This much has already been said that *circulation itself is a moment of production*, since only through circulation does capital become capital. […] The more production comes to be based on exchange value, and thus on exchange, the more important for production do the *physical* conditions of exchange become—the means of communication and transport. […] Circulation can create value only in so far as it requires additional employment—of alien labour—additional to that directly consumed in the production process (Marx 1993, 444–448,472 emphasis added).

From Marx, we see capitalism's evolution (towards a third-phase) that "the physical conditions of exchange"—or as in the predominately urban and urbanizing world, *the urban* – become ever more important for production. In CCC, then, the urban is vital socio-material space, an outcome of a more generalized urbanization process, for cognitive and cultural production. From Marx, we also see that circulation is part of the broader production process and surplus value can be added to the commodity if additional labour is applied for circulation. In this sense, we find immaterial labour to be caught in the realm of circulation and realization without connecting to the entire Marxian *circuit of capital* or to Harvey's *circuits of cap-*

ital. Here it is worth noting that we do not wish to conflate conceptualizations of immaterial labour with digital labour. Instead we see digital labour as a subset of immaterial labour that is directly engaged with the use, production or prosumption of digital ICTs. However, we note that immaterial labour and the digital labour subset rely on a specific configuration of capitalism and capitalist circulation involving planetary urbanization, digital technologies, and fixed capital infrastructure.

3.2. Circulation as Production and Materiality of Immaterial Labour

As other theorists have noted, media, as a force on the relationship between time and space, is primarily concerned with circulation (Manzerolle and Kjøsen 2012). We suggest that because media and circulation are sensitive to time and space (communication and transport), media and circulation thrust planetary urbanization, circulation labour, and technological advancements centre stage in a competitive race to realize profit. This focus necessitates heeding Smythe's call to demystify the materiality of digital labour (Smythe 1981; Fuchs 2012c). We must examine beyond the production of a digital ICT device and beyond the labourer (user) interacting with the device. We examine the materiality of immaterial labour as human action that metabolizes nature through a socio-environmental relationship and shapes the consciousness of humans.

Similar clarifications have been made regarding materiality in seemingly immaterial sectors of industrial and economic development. Questioning the growing literature on the so-called "service" economy, Walker refuted the idea that the service labour of the "service" economy were in fact services. The rising temporal, spatial and technological complexity of industrial production meant that labour analysis was particularly difficult (1985). What we might call "service" labour – or even immaterial labour in media studies – is not a service at all. That is, "capitalist industrialism has not been transcended, but simply extended, deepened and perfected… the great majority of 'services' are the classic activities of a goods producing, industrial economy" (Walker 1985, 71–72). Walker's main argument is that the so-called service economy is comprised of what might be called immaterial activities.

> [The service economy] rests on the productive power of the industrial system. Consumption levels have risen and products proliferated. With the mass production and consumption of goods has come the mass of labor engaged in distribution centers, retail outlets, elaborate sales efforts, and transportation. The value produced along with the goods circulates through a massive financial structure, speeding exchanges, bridging time and space, leveraging capital accumulation. Specialized appendages have sprouted on this financial edifice, from leasing companies to secondary mortgage markets. Information about the economy swirls through communications channels created by that industry. Armies of managers rule over the system, paid out of the surplus of those they supervise; alongside them come the specialists in management inputs. In short, an enormous superstructure has been erected on the value and wealth generated by modern industry (Walker 1985, 72–73).

Merrifield, building on Lefebvre, conceptualizes the service economy as a "specialized appendage" of capitalism that includes financial structures and adds value through realization. This form of labour *is* the urban society and intricately linked to the urban (Merrifield 2013b, 23). Today, the temporal, spatial and technological complexity of industrial production has only increased and cities play a central role. Mass production and mass consumption have proliferated and developed, necessitating technologically advanced mass labour engaged in detailed production coordination, technologically advanced distribution centres, complex, targeted, and individualized sales and advertising, and advanced tracking and transportation. The financial structure has largely digitized, and new information about markets is leveraged in new financial instruments. Digital ICTs allow for the increased velocity of financial, communication and consumptive exchanges. New "armies of managers" are necessitated with the growth of these labour activities. Numerous forms of labour activities are involved in the production process by increasing the velocity of capital circulation so that the capitalist can realize profit sooner. Circulation, according to Marx, is itself a moment of production because

it is only through circulation that capital becomes *capital.* In short, the enormous superstructure shaping, and shaped by, modern industry continues to become more complex.

In summary, a contemporary Marxian political economic analysis of digital technologies and digital labour requires the examination of the material infrastructure and flows that makes possible the addition of surplus value in circulation as a moment of production. In practice, this requires research on everything that happens "beyond the screen." Within digital media studies this may be focused on what happens both before and after a blog post is submitted, a post is liked, or a photo is uploaded. When a user accesses a Facebook image or post on a smartphone, the necessary Facebook content is retrieved and submitted through cell towers or an internet connection. Yet, media and communications scholars have not questioned where the material data is being stored and copied or how the data is being transmitted. Looking "beyond the screen" might involve research on the armies of labour activities and fixed capital infrastructure that make operation of digital ICT devices possible.

In the next section we will begin to examine the sites of, and actors involved with, data storage and transmission. Digital ICT devices are communication devices after all, and are materially connected to (digital) servers through (digital) infrastructure. It is through an examination of these sites of digital storage and communication that we gain a more comprehensive understanding of capital accumulation.

4. Materializing Digital Labour

We suggest that examining the geography of digital ICTs and digital labour under the planetary urban condition is a necessary step to analyse the materiality of digital labour. That is, the symbolic analysis and cognitive work of digital labourers is made possible only by their necessary connection to massive data storage and processing centres. This understanding raises several questions: What are the socio-spatial characteristics and impacts of these digital infrastructures? Where are data centres located and why in those specific locations? What are the socio-material impacts and benefits of data centres and how are they distributed? To answer these questions, an unearthing of the infrastructures of digital ICTs beyond the screen, both connections and nodes, becomes an essential task.

4.1. Data Centres and Energy Use

Data centres are far from cloud-like auras. Data centres are massive structures housing thousands of servers for storing data, advanced mechanical cooling and ventilation equipment, batteries and diesel generators for backup power and redundancy, and depending on the location and owner, a highly securitized shell of fencing and walls with limited access areas and surveillance systems. In a popular New York Times story in 2012, data centres were indicted for their energy intensive characteristics (Babcock 2012; Glanz 2012). The article pointed to Facebook's now seemingly "quaint" beginnings with only 10 million users, and how the company encountered data storage dilemmas of overheating, space limitations, and memory limitations at an early phase. Compared to today's scale, with the immensity of data produced by 1 billion users and stored on Facebook's data servers, their tiny rental space storing data used for the site in 2006 seems almost comically small.

By design, data centres are energy intensive. As the New York Times reported (these "cloud factories" use about 30 billion watts of electricity worldwide, roughly the same as 30 medium-sized nuclear or coal-fired power plants. Some data centres require "more power than a medium-size town" (Glanz 2012), and for this reason, "data centres are among [electric] utilities' most prized customers". The polluting impacts of the immense, steady demand on predominately coal-fired power facilities has exposed big data's 'dark side' (Oremus 2012), and even worse, the New York Times investigation showed that up to 90 percent of the energy consumed was wasted. In fact, data centres use 2% of all energy in the United States, which pales in comparison to 'dirty' industries like the paper industry (Oremus 2012).

The data centre industry responded first by addressing the errors in the New York Times analysis (Wilhelm 2012), and second, by improving energy efficiency and investing in renewable energy sources, effectively, or at least discursively, 'greening' their data centre opera-

tions (cf Amazon.com 2014; Google 2015c). Facebook's Prineville, Oregon data centre is representative of the most efficient 'modern' data centres, which have much improved power usage effectiveness (PUE, or energy used overall divided by energy used for computing) from approximately 2.0 to near 1.07 (Babcock 2012). The technical characteristics of data centres, including their energy and land requirements, have shaped locational choices by data centre owners such as Facebook and Amazon: free air-cooling, low electricity rates, inexpensive land, and enterprise zones that limit taxation in places like Prineville, Oregon are key decision points. This poses further questions about the politics of development in places struggling to attract capital for economic development and jobs creation.

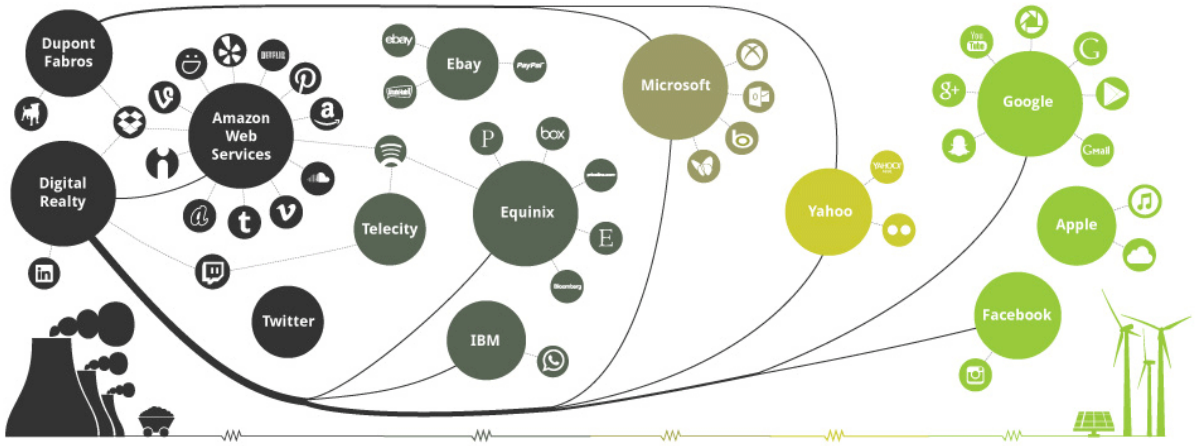

Figure 1: Greenpeace report on data centre sustainability (Cook and Van Horn 2011).

Non-governmental organizations have also stepped in to advocate for advancements in reducing polluting impacts and intensive energy consumption of data centres (McMillan 2014). Greenpeace, in particular, has focused on 'clicking clean' as an environmental strategy to influence companies like Amazon Web Services to use cleaner sources of energy. Despite attempts to increase the efficiency of data centres, the overall growth in data storage needs represents something of a Jevon's paradox that fuels more consumption and production of data and energy. In the era of "big data," where data is leveraged to solve all manner of social and environmental problems, expansive data centre growth is an established trend.

4.2. The Geography of Data Centres

In Table 1 we show the data centre locations of three large trans-national internet-based corporations: Facebook, Google and Amazon. The US state of Oregon has large data centres for all firms. Facebook has a large data centre in Prineville, Oregon. Apple, missing from the table, does not disclose all their locations, but also has a data centre next to the Facebook's Prineville, OR data centre. Google developed a data centre just east of Portland in The Dalles; it is one of only a handful of data centres whose value is over $1 Billion USD (Miller 2013) and is featured regularly by the company because of its aesthetically pleasing internal design (Google 2015b). The data centre is located on the Columbia River dividing Oregon and Washington, adjacent to hydro-power facilities.

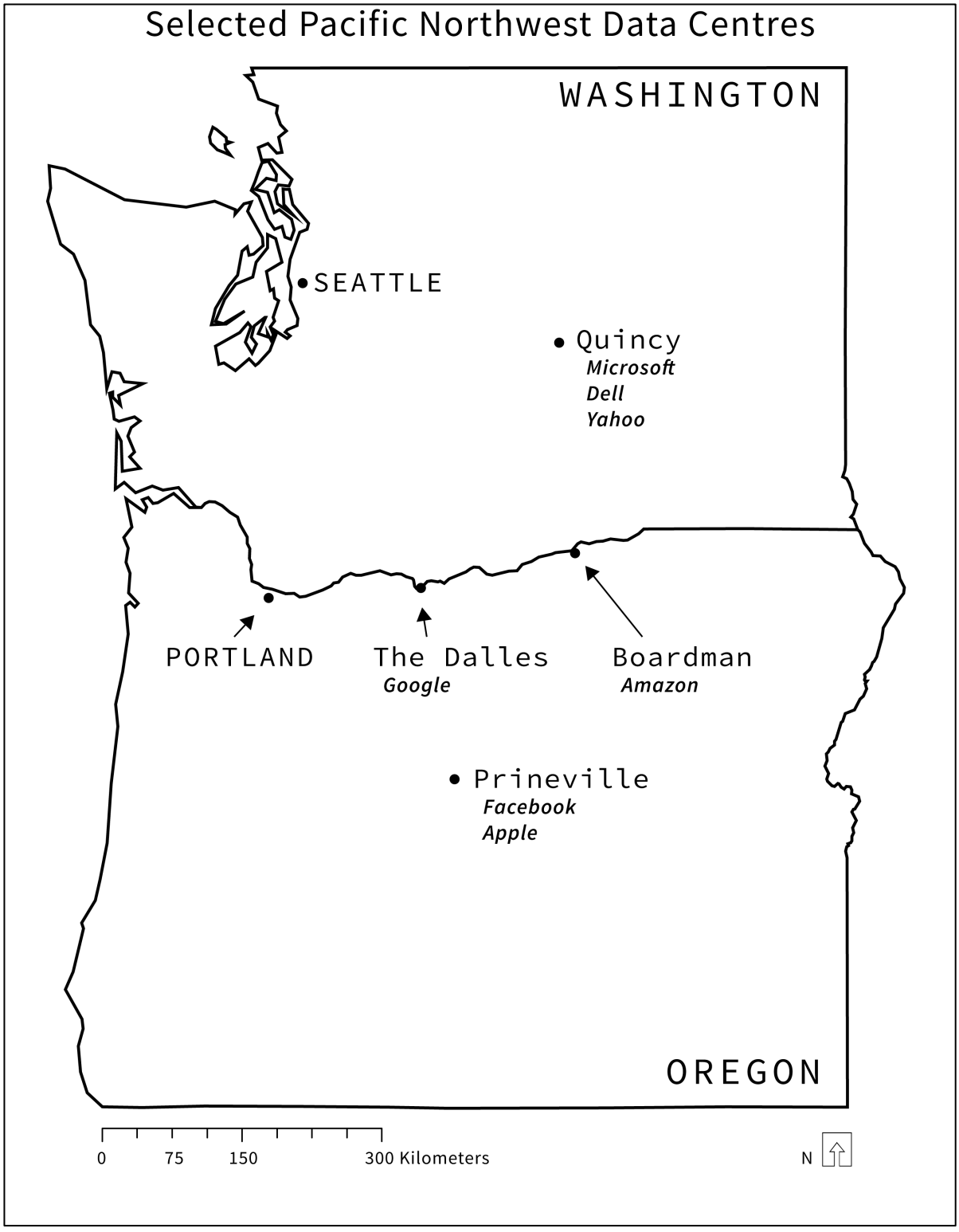

Figure 2: Selected Pacific Northwest Data Centres, see also Table 1

Amazon provides caching locations – small collections of servers that store data in locations more proximate to its users – outside major metropolitan areas throughout the western coast of the US. Amazon does not disclose specific locations of their data centres, however, at least one data centre exists in Boardman, Oregon (Rogoway 2011) and Amazon discloses that it has caching centres around large urban areas (Amazon.com 2015a). Amazon has planned expansion of data centres in rural Oregon pending Oregon's state legislature deci-

sion regarding tax exemption for the facilities (Rogoway 2015a). Apple is also planning an expansion of the Prineville facility after both state tax changes and the expansion of the electricity capacity developed by the city of Prineville and Cook County. Quincy, Washington is home to one of the world's largest data centres owned by Microsoft and other large data centres from Dell and Yahoo.

These large firms do not have data centres in or around their Silicon Valley-based headquarters. Yet, firms locating their data centres in Oregon is no accident. Access to numerous intra- and international long-haul cable connect the region to other cable connections, providing high-bandwidth access across the globe. Inexpensive land, inexpensive hydro-power electricity, and high-bandwidth capacity make Oregon a prime location for data centres (Miller 2012a). Rising interest in building data centre's in Oregon led the Oregon government to reduce or remove property taxes on "intangible" and "hard to quantify" assets like company branding and computer equipment. During the state legislative hearings, Google and Amazon both testified that the original tax was preventing the companies from expanding their technical infrastructure. Google claimed that without the tax break, it could not develop its Google Fiber internet infrastructure in the city of Portland (Rogoway 2015c). The state elected to remove the tax hurdle, making exceptions for tech companies and their infrastructure. Shortly after the change in tax code, Amazon announced plans to build 11 more data centre's in the region (Rogoway 2015a). Similarly, Washington state, just north of Oregon on the other side of the Columbia River, passed a similar tax break targeted for data centres (Miller 2015b). In Oregon, the tax breaks made building data centres close to the city possible. Hillsboro, within the Portland metro region, is the future site of a reasonably sized 18,500 square meter data centre (Rogoway 2015b). Hillsboro is the terminus of three major long-haul cable submarine lines (Tyco Global Network Pacific, Southern Cross, and Trans-Pacific Express) connected to sites in Northern California, Japan and other places in Southeast Asia. Each cable line is over 20,000 km long (Submarine Cable Networks 2015). Within the Portland region, there are numerous land-based high-capacity long-haul cable connections to: Seattle and Tacoma in Washington; Boise, Idaho; Palo Alto, San Jose and Santa Clara in California; Cheyenne, Wyoming; and Kansas City, Missouri (TR 2014). A loop system that connects the Oregon coast and central Oregon's data centre's exist through a connection in Medford, Oregon (TR 2014).

Table 1 also shows the population of the nearest municipality for each data centre, the nearest large metropolitan area, and the nearest global city as defined by Beaverstock, Smith, and Taylor (2000) and Sassen (2009). These massive data centres do not merely serve the populations of the small municipalities where they are located, nor are the designed to serve the nearest large metropolitan area—which, for the Oregon data centres, is the Portland metropolitan region. This is not to diminish the growing agglomerations of software and technology companies in the Portland region, but simply acknowledging that the region is what Mayer (2012) calls a "second-tier" region known for its high-tech industries, but not of the scale of Silicon Valley or Los Angeles. Portland is known as the home of the annual Open Source Software Conference, home of the inventor of the wiki, home of the inventor of Linux, the location of Intel's largest manufacturing site and patents, and part of growing software and technology scene (Rogoway 2014). The two closest regions over 1 million in population have significant technology clusters. Seattle metro, the first region, is 280km to the north and home to enterprise software firms Microsoft and Amazon (see also Figure 2). We refer to Amazon as a software firm because of its significant offerings for data storage, database management and its extensive network of servers which double to as digital infrastructure for its retail website. Silicon Valley, the second region 1,000km to the south, is well known throughout the world and home to numerous technology companies, such as Facebook, Google and Apple (Silicon Valley includes the neighbouring metro regions of San Francisco and San Jose metro area).

Data Centre	Population	Nearest metro over 1mil in population	Nearest global city**
Facebook			
Prineville, Oregon, USA	**9,000**	**Portland, OR**	**Los Angeles, CA**
Forest City, North Carolina, USA	7,000	Charlotte, NC	Atlanta, GA
Luleå, Sweden, USA	46,000	Stockholm	Copenhagen
Google			
Unincorporated Berkeley County, South Carolina, USA	194,000	Charlotte, NC	Atlanta, GA
Council Bluffs, Iowa, USA	62	(Omaha, NE)	Chicago, IL
Unincorporated Douglas County, Georgia, USA	132,000	Atlanta, GA	Atlanta, GA
Quilicura, Chile	200,000	Santiago, Chile	Caracas, Venezuala
Unincorporated Mayes County, Oklahoma, USA	41,000	Oklahoma City, OK	Chicago, IL
Lenoir, North Carolina, USA	18,000	Charlotte, NC	Atlanta, GA
The Dalles, Oregon, USA	**15,000**	**Portland, OR**	**Los Angeles, CA**
Changhua County, Taiwan/China	1,400,000		
Singapore	5,500,000	(Singapore)	(Singapore)
Hamina, Finland	21,000		
Saint-Ghislain, Belgium	22,000		
Dublin, Ireland	1,100,000	(Dublin, Ireland)	London, UK
Eemshaven port, Groningen, Netherlands	580,000		
Amazon US Data Centres			
Boardman, Oregon, USA*	**3,000**	**Portland, OR**	**Los Angeles, CA**
Unspecified, Northern California, USA*	NA	NA	Los Angeles, CA
Unspecified, Northern Virginia, USA*	NA	NA	Washington, DC
Unspecified, "GovCloud" USA*	NA	NA	NA

* Amazon data centre locations are approximate since Amazon does not disclose their exact locations.
** Nearest "global city" according to Beaverstock, Smith and Taylor (2000) and Sassen (2009).
Data centre locations from gather from news sources and company websites (Amazon.com 2015a; Miller 2008; Miller 2011; Miller 2015; Google 2015b).

Table 2: Advertising and data revenue in millions (USD) for 2014

Company	Total Revenue	Advertising Revenue	Advertising Share of Revenue
Amazon	$88,988	$1,000*	1%
Facebook	$12,466	$11,653*	93%
Google	$66,001	$59,624	90.3%

Company	Total Revenue	Data Service Revenue	Data Services Share of Revenue
Amazon	$88,988	$6,200*	7%

* estimates
Amazon data from 2014 Annual Report (Amazon.com 2015b). Amazon advertising revenue estimated (Greene 2014). Amazon data services estimated (Babcock 2013). Facebook data from Facebook Investor Relations, advertising revenue estimated for Q4 2014 based on expectation (Facebook 2015). Google data from Google Financial Tables (Google 2015a).

Table 1: Data Centre Locations for Facebook, Google and Amazon

In this paper, we have highlighted Facebook, Google and Amazon as emblematic of the cognitive-cultural economy and representative of a cross-section of cognitive-cultural firms. These firms are undoubtedly trans-national digital technology and digital labour firms with a near universal presence within the United States. While not necessarily direct competitors, each firm has overlapping customer segments and all three rely on advertising as a source of revenue. Total revenue and advertising share of revenue is listed in Table 2. Facebook's social media platform is an advertising platform for its advertisers. Google, often thought of as a search-engine company, is primarily an advertising firm, which offers numerous other services like Gmail, mapping platforms, business platforms, Google Music streaming, Google Books, and support for its Android phone-based operating system. Amazon, often thought of

as an online store, offers data storage, database management and caching services ("cloud computing") in addition to supporting its digital offerings for Amazon Books and Amazon Music. We do not discount Amazon's significant online retail store's 2014 revenue of nearly $70 billion USD (Amazon.com 2015b), but also point to the shift of traditional retail competitors like Walmart and Target into the online space.

What becomes clear is the geography of production in cognitive-cultural capitalism. We show that a clustering of data centres in Oregon and the broader Pacific Northwest contrasted with a few data centres near the headquarters of trans-national internet-based and digital technology corporations Amazon, Facebook and Google. Portland, the nearest metro to many of the data centres, does not have the digital labour force or market to necessitate the capacity built in rural Oregon. Instead the regional digital labour and global reach of digital products produced by regional labour necessitate data centres near, but not at, the site of digital labourers. Urban high-tech and information technology firms and residents benefit from the use of data centres, utilizing technological networks and data centres located in the 'hinterland' with little or no benefit to rural municipalities (Glanz 2013). This geography complements the work by other scholars to understand the geography of domain name registrations during the dot-com era that demonstrated that registrations were not only dominated by Silicon Valley, but also concentrated in large urban areas (Zook 2000; Zook 2007).

Understanding the economic geography of labour and digital infrastructures, as shown in our analysis, helps to position the arguments about the uneven socio-environmental impacts of planetary urbanization under cognitive-cultural capitalism. Key to this understanding is how agglomerations of digital labourers – that is workers in high-tech and software industries which produce digital technologies that leverage digital ICTs – concentrate in urban areas. Amazon, Facebook and Google are, again, emblematic of cognitive-cultural capitalist production. Digital labourers performing symbolic and cognitive work in urban areas develop software and hardware for advertising to increase the velocity of consumption of existing material goods (Amazon does so directly). In other words, digital ICTs and digital labourers are employed to increase rate that capital is realized. We argue that the socio-environmental impacts are separated from the site of the symbolic and cognitive work of the digital labourer, producing uneven geographies of production, fixed capital infrastructure development, and socio-environmental impacts.

4.3. The *Urban* Political Ecology of Data and Capital Circulation

To analyse these socio-environmental impacts, we employ an urban political ecology (UPE) framework that builds on Lefebvre's notion of planetary urbanization. The UPE framework offers a more comprehensive understanding of digital labour and its explicit connection to places like rural Oregon and the broader Pacific Northwest. The globally connected data centres in Prineville, Boardman, and The Dalles, Oregon and Quincy, Washington power and enable the growth of technology agglomerations in urban areas on the west coast. When considering the socio-environmental impacts, the "clean" digital labour in urban areas is in stark contrast to the energy intensive digital machinery in rural areas. Expansions from Amazon, Google and Facebook in their Oregon data centres suggest that the relationship between these trans-national corporations and rural Oregon municipalities is favourable to both rural residents and the corporations. However, as we argue, the economic development benefits of data centres for rural Oregon are miniscule in comparison to the markets that they fuel. These data centres *are backbones of the infrastructures* that are used to increase the velocity of consumption of material goods through advertising and distribution. And, at the same time, the rural regions of Oregon are left with the negative socio-environmental outcomes associated with energy sourced from non-renewable sources.

In general, UPE explains how urban processes shape the way natural resources, or "natures," are manipulated and exploited while concurrently analyzing how urban metabolism and circulation—flows of resources into and out of the city – unfold in the context of uneven power relations, producing enabling and disabling social and environmental conditions (Heynen, Kaika, and Swyngedouw 2006). Early work in UPE focused on the intricate connec-

tions between Lefebvrian notions of the urban and marxian views of metabolism to frame the human-environment relationship (Keil 2003; 2005). The focus of this research was on "the very networks of 'fetishized' urban infrastructures that urban political ecologists [...] described as the product of protracted struggles over the modernization of cities" (Keil 2005, 645). Networked infrastructures are "material mediators between nature and the city" (Kaika and Swyngedouw 2000, 120). And, despite new lenses on power relations and new objects of analysis (Lawhon, Ernstson, and Silver 2014), UPE retains a strong empirical focus on infrastructures and the materiality of cities in relation to environmental change (Monstadt 2009). Our discussion of digital ICT infrastructures (i.e. data centres) is supported by much of the scholarship on UPE which has traced how infrastructures can be unpacked to reveal the dynamics of spatio-historical capital accumulation processes, highlighting how capitalist power is enacted through urban materialities and class relations.

> Under capitalism, the commodity relation and the flow of money veils and hides the multiple socio-ecological processes of domination/subordination and exploitation/repression that feed the urbanization process and turn the city into a metabolic socio-environmental process that stretches from the immediate environment to the remotest corners of the globe […] The environment of the city is deeply caught up in this dialectical process and environmental ideologies, practices and projects are part and parcel of this urbanization of nature process […] In sum, the political-ecological examination of the urbanization process reveals the inherently contradictory nature of metabolic change and their techno-natural 'metabolic vehicles' and teases out the inevitable conflicts (or the displacements there-of) that infuse socio-environmental change (Swyngedouw 2006, 106,115).

Following Swyngedouw, we assess the urban as a planetary "metabolic socio-environmental process" that at its very foundation is an outgrowth of capitalism. The transformation of nature and social relations inscribed within them are inextricably linked to urbanization (Smith 2008; Swyngedouw 2004; Swyngedouw 2006). If the urban is the "excrescence of the circulation of capital," then it takes on a socio-spatial form in relation to the mode of production. In cognitive-capitalism, this has meant a return to the urban centers, coupled with gentrification, and physical manifestations of the "new" division of labor in uneven geographical development that is global in scale. However, the focus on the city, with a token acknowledgement of those "low-value" spaces outside the city, has, at least in empirical research, left a gap in our understanding of the distant infrastructures that facilitate circulation and flows of "metabolized nature" in the form of capital, people, resources, and as we suggest for contemporary capitalism, data and information. In our empirical study above, we took account of the "remotest corners of the globe" that are no less involved in a digitally-facilitated urbanization process than the city itself.

5. Conclusion: Planetary Urbanization and Cognitive-Cultural Revolution

Wyly's (2013) extension and critique of Scott's work on cities of the third-wave provides us with a further consideration for interlinking the immaterial labour of CCC with Marx's own thinking on how "knowledge and human experience were becoming endogenized into the materiality of capitalist production" (390). Wyly quotes this epigraph from the *Grundrisse* to emphasize this point:

> Nature builds no machines, no locomotives, railways, electric telegraphs, self-acting mules etc. These are products of human industry; natural material transformed into organs of the human will over nature, or of human participation in nature. They are organs of the human brain, created by the human hand; the power of knowledge, objectified. The development of fixed capital indicates to what degree general social knowledge has become a direct force of production, and to what degree, hence, the conditions of the process of social life itself have come under the control of the general intellect and been transformed in accordance with it. To what degree the powers of social production have been produced, not only in the form of knowledge, but as immediate organs of social practice, of the real life process (Marx 1857/58, 706, emphasis in original).

The development of fixed capital, as we investigated in the infrastructures of digital ICTs, indicate the immense "degree general social knowledge has become a direct force of production." Certainly, this is inscribed in the process of planetary urbanization, which as Lefebvre noted, relied more and more on a process on "post-employment" or unwaged work (i.e. prosumption or audience labor). Together with Merrifield's suggestion that we are witnessing the urbanization of the general intellect, Lefebvre's thesis of complete urbanization should raise questions about the nature of labour in an urban society. As Merrifield (2013c) notes, "[the] degree to which human ingenuity, human imagination, scientific know-how and the vital powers of the human brain and hand have become objectified in fixed capital – capital that apparently rules over us – is the degree to which urban society defines our lives" (78).

We showed that digital ICTs are sophisticated manipulations of nature that require and illuminate new ways of thinking about digital labour, and more broadly, of immaterial labour. We suggest that the immaterial labour associated with digital ICTs is actually material labour involved in increasing the velocity of circulation as a moment of production, an appendage of the growing complexity of third-phase capitalist industry and urbanization. Unearthing the uneven geographies of digital ICT infrastructures, especially those beyond the screen, is an essential task for understanding the socio-environmental impacts of digital ICTs. Referring back to Marx and Engels, the cognitive, cultural, and symbolic work of digital labourers coincides with the argument that "the greatest division of material and mental labor is the separation of town and country" (Marx and Engels 1978). More importantly, the materiality of cognitive, cultural, and symbolic *labour* reaches beyond the city, invades the lifeworlds of a planet of urban residents, and produces uneven socio-environmental impacts producing beyond the city itself.

We demonstrated in this paper that the socio-environmental impacts of digital ICTs can fully be analyzed only if we consider the materiality of digital labour and digital ICT infrastructure. We illustrated this first by connecting analysis of digital ICTs to the co-evolution and geography of planetary urbanization and technological change, and second, relatedly, by connecting seemingly immaterial, digital, labour to the material industrial production system. Through an examination of data centres, we connect third-wave urbanization and its planetary reach into the pristine landscape of rural Oregon. Data centres in Oregon, and the broader Pacific Northwest, highlight the uneven geography of "clean" digital labour focused in large urban technopoles, the potentially harmful socio-environmental impacts of data centres in rural areas, and the necessary and dialectic relationship between the two for cognitive-cultural capitalism. The massive material infrastructure "beyond the screen" makes digital labour possible, and at the same time, positions rural localities as the bearers of new energy-intensive industries with little local socio-economic benefit. Together, digital ICTs and digital ICT infrastructure embody dialectic and material representation of both dead labour and the general intellect – shaping new, and uneven, socio-material natures and futures.

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Commons, Piracy, and the Crisis of Property

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Abstract: This article takes the politicisation of copyright and file sharing as a starting point to discuss the concept of the commons and the construction of property. Empirically, the article draws on a series of interviews with Pirate Party members in Sweden, Australia, Germany, the UK and USA; placed in the theoretical framework of the commons. We argue that piracy, as an act and an ideology, interrogates common understandings of property as something self-evident, natural and uncontestable. Such constructions found liberal market ideology. The article has two broad aims: to briefly outline how the enclosure of the commons can be applied to different kinds of resources, from the physical commons, to the institutional and finally the cultural commons.; and to discuss the way that piracy highlights the emergent crisis in private property rights, brought to the fore by the global financial crisis and ongoing privatization of public resources. We conclude by questioning what new modes of enclosure are emerging in a digital economy driven by excessive data mining and centralized streaming services.

Keywords: Piracy, Pirate Party, Commons, Private property, File-sharing

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In the 1995 cult classic film, *The Usual Suspects,* the character played by Kevin Spacey, 'Roger 'Verbal' Kint' states that: "The greatest trick the Devil ever pulled was convincing the world he didn't exist" (Singer and MacQuarrie 1995). 'Verbal' is describing the existence of a master criminal, Keyser Soze, that everyone feels is everywhere and hears everything, yet no one has ever seen and, in fact, no one is really sure exists.

We choose to enter a discussion about the commons, property and piracy from this position because it captures contemporary conceptualisations of property rights. Rather than being understood as something socially constructed, contemporary neoliberal economic orthodoxy imagines property rights as a natural phenomenon that exists everywhere and is never to be challenged. Like Verbal's Devil, neoliberal property rights are invisible, incontestable and undoubted.

1. Introduction

A more conventional way to make this point is to draw on Michel Foucault's "triangle of power" (2003). In his lectures at *College de France* in 1976, Foucault discusses mechanisms that establish a link between "power, right and knowledge" and asks, "What rules of right are implemented by the relations of power in the production of discourses of truth?" (Foucault 2003, 93). The triangle is sourced to sovereign power, whether that of the monarch, or "King" (ibid., 94), the "sovereign power" of states (Agamben 2005), or the current neoliberal regime (Arvanitakis 2007). This is a regime that has re-shaped global economic priorities around deregulation: that is, the removal of economic and other safeguards in favour on unrestrained profit-seeking, as well as reduced government spending on essential services.

In this context, the neoliberal property rights agenda is clear-cut and near universal. Property rights are perceived to be natural and normal, such that alternatives are not seen to even exist (Hardt and Negri 2004; Lewandowska and Ptak 2013). It is important to note then when discussing neoliberalism, we are not only referring to a series of economic policies that

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prioritise the unregulated markets and private property rights (Dawson 2013), but in the words of Giroux, "a slavish celebration of the free market as the model for organising all facets of everyday life" (2003, 4). According to Mirowski (2001, 432), this ideological position leads to a predisposition to oppress alternatives leading to a single moral genealogy of our histories.

Socialism, communism and fascism may all be presented as ideological positions, but neoliberalism like "Verbal's" Devil, is invisible, normalised beyond a tangible existence, simultaneously everywhere at once, yet nowhere to be seen. That is to say, the moral genealogy described by Mirowski (2001) and echoed by Hardt and Negri (2004) and Lewandowska and Ptak (2013) means that the private ownership of property and market dynamics are rooted "in nature, rendering them autonomous and determined by the natural "laws" of supply and demand" (Milberg 2001, 411)

Over the last decade, our research has focussed on alternatives to private property rights with specific attention to the commons. The commons have existed both in parallel to private property and as an alternative to it. The complex interplay between the commons and private property rights has been well documented (see Ostrom 1990, 2009; Lessig 2004)—as have the many processes of enclosure in both the material and immaterial world (Bollier 2002; Linebaugh 2014). Our interest here is to further explore the relationship between commons and neoliberal property rights, and also to look at how conflicts over the enclosure on immaterial resources, such as art and information, expose the arbitrary nature of property.

Here, we find that acts of "piracy" are a driver *and* a consequence of this relationship and the associated interactions. As such, this paper has two broad aims: the first is to briefly outline how the enclosure of the commons can be applied to different kinds of resources, from the physical commons, to the institutional and finally the cultural commons. In doing this, our aim is to weave together a cross section of literature that has delved into these processes over the last three decades. Such processes can be traced back centuries and have taken many different forms.

The second aim is to investigate how piracy both creates and responds to the enclosure of the commons and, in so doing, highlights a crisis in private property rights. Our driving research question then, is: is piracy merely an act of individual gain or a response to the enclosure of neoliberal private property rights?

Before continuing, it is important to outline our methodological approach. We combine theoretical and analytical perspectives with empirical examples that capture how the concepts of property and the enclosure of the commons are reflected in the acts and politics of piracy. These examples draw on a series of semi-structured interviews with representatives and activists associated with pirate parties across Sweden, the UK, Germany, Australia, the USA and Canada. The data mainly consist of semi-structured interviews; alongside material such as websites and party platforms. The majority of the interviews were conducted individually, with the exception of three interviews that included 2-3 participants. All interviewees play important roles in their local Pirate Party, but these roles differ significantly due to the heterogeneity of the parties. Two of the interviewees are members of the European Parliament, and thus professional politicians, while the vast majority are amateurs, dedicating their spare time to party work.[1]

Additionally, we are actively engaged in the debates that are outlined here—as activists and scholars. This engagement is driven by an aspiration for justice: it is dynamic, reflective, participatory and interactive. We draw on feminist insights such as those of Mies (1991) and Livholts (2012), as well as post-colonial authors including Said (1979) and Nandy (1983). As participant-researchers we are agitating to identify and confront injustice and alienation, not simply observing and reporting. This approach rejects the concept that there is one objective form of inquiry or knowledge (Stanfield 1998). The benefit of this approach is in creating a pluralism that is reflective of the heterogeneous nature of society, property rights and all those we engage with from the broader community.

[1] Riksbankens Jubilemsfond—The Swedish Foundation for Humanities and Social Sciences, in large part funded the project described in this paper. For a more detailed account please see Fredriksson (2013; 2015).

2. The commons: their existence and enclosure

The concept of the commons can be traced back to Ancient Rome with discussions of the *Res Commons* (Barnes et al 2003). At the time, the Romans distinguished between three basic types of property: *res privatae* was private property; *res publicae* was public property owned by the authorities and *res communes*—natural things used by all, such as air, water and wild animals. This latter category represented what everyone shared but no one owned (Arvanitakis 2007).

Over the centuries we have come to understand different types of commons. The common lands of the United Kingdom in the Middle Ages, for example, were used by villagers for foraging, hunting, planting crops, and harvesting wood (Reid 1995). These rights were set down in the Magna Carta of 1215 (Barnes et al 2004). We also have global commons: the atmosphere and the high seas—oceans beyond the territorial zones of nation states. The concept has also been applied to represent other resources, including the infrastructure that allows our society to function (such as the water delivery and sewerage systems) and public space such as parks (Blomely 2008). Within this broader category we can identify institutional commons: public hospitals, public broadcasters and public education—institutions whose benefits are spread throughout the community (Bollier 2002).

This institutional dimension of the commons is also an important part of the work of renowned economist, Elinor Ostrom (1990). Ostrom argues that our relationship to commons such as water requires different institutional arrangements. Ostrom's behavioural economics approach proposes that while resource markets often fail, institutional arrangements focussed on the commons create robust management structures and programs built on cultures of context, cooperation, communication and reciprocity (Ostrom 1990). As such, we include within the institutional commons management structures based on principals that extend beyond commercial exchange, which she describes as 'adaptive governance'. This is not a free exchange, but one that requires institutional arrangements that assist all stakeholders to identify the 'fair value' rather than create a market mechanism that excludes those who cannot afford to pay.

The concept of the commons has also been used to describe biodiversity, or "genetic commons" (Shiva 2000). Included here is the human genome that makes us a unique species and the biological diversity that makes Earth a unique planet (Robinson et al 2014).

The concept is not limited to the material, but is entering the immaterial. For example, David Bollier (2002) and Lawrence Lessig (2004) explore what they describe as the 'knowledge commons'. This is the information and knowledge that come to define communities and create common reference points. Knowledge commons range from literature to the performing and visual arts, design, film, radio, community arts and heritage sites. Bollier and Lessig are referring to the actual knowledge that emerges as well as the infrastructures of provision, such as the Internet and public institutions that produce knowledge—universities, technical colleges, schools of art and drama. Recently, these kinds of immaterial commons have also been explored in relation to the material commons that Ostrom and her colleagues began investigating in the 1990s (Hess and Ostrom 2006; Frishmann et al. 2014).

The immaterial conceptualisation spreads into the 'information commons' that has had a particular political impact in the copyright debates that emerged since the late 1990s. A cornerstone here is James Boyle's (2003) extensive research on the *Second Enclosure Movement*. In several works Boyle discussed how intellectual property is used as a means to privatise a growing range of previously common resources. Many other scholars had made a similar point, but by speaking of a second enclosure process, Boyle conceptualised the privatisation of immaterial resources as analogous to the enclosure of public space and agrarian land (Boyle 1997, 2003; 2008; c.f. Thompson 1963)—and as we note below, a process of primitive accumulation.

Continuing Boyle's line of argument as we outline each of these, it is also possible to track how each form of the commons has also been the subject of enclosure. From the old English common land to the ongoing enclosure and privatisation of public institutions, these commons have slowly disappeared (Lessig 2004; Arvanitakis 2007; Linebaugh 2014). They have

been privatised and gradually sold off, and like the enclosure of the lands, the benefits have been unevenly shared (Bollier 2002 Lessig 2004). And as the enclosure of the commons land in the United Kingdom drove the industrial revolution and led to unprecedented levels of highly concentrated material wealth, so have the benefits that flow from the enclosure of the institutional commons and knowledge commons been concentrated and led to the material expansion and benefit to very few (Boyle 2008).

Let us return to 'Verbal's' Devil: the slow progression of enclosure has been identified as inevitable and occurs in an almost invisible process (Blomley 2008). Tracing back to E.P. Thomson's (1963) description of the commodifying tendencies of capital that led to the enclosure of the commons, to Garret Hardin's (1968) essay of the "Tragedy of the Commons" that argued only privatisation could save shared space, to the 'end of history' thesis that argues for clear private property rights (Fukuyama 1992), commons have essentially been labelled as "economically useless" (Wood 2003: 13). In fact, Bollier (2006) argues that both the concept and term "commons" have become unfamiliar in the modern world and are often simply ignored in literature (Blomley 2008). We see this in the majority of economic textbooks that argue, if private property rights are not or cannot be appropriately defined then market failure will result (see McTaggart et al 2010). Those wanting to keep institutions in the public domain—or more accurately, in the domain of the commons—are accused of having a left-wing bias and retarding economic development (Hughes 2004). As such, the removal of institutions that have been built over generations from the commons to private hands is not ideology—it is presented as efficient, normal and a form of economic progression—rather, is the "right" that was described by Foucault (2003).

3. The social and cultural commons

In response to the invisible and "natural" processes of enclosure, we want to argue that both the existence and reciprocated exchange of the commons is fundamental in the functioning of authentic and vibrant communities (Arvanitakis 2009). The specific focus here is the knowledge commons and we can start this journey by concentrating on the community of academics. As academics, we rely on the knowledge commons for our community to function: the free and open sharing of our intellect, research, theorising, reflection and hard work. This is the process of peer review, conference attendance, engagement, feedback and discussion.

This approach to academic knowledge has historical significance and each one of us, to use a vernacular phrase, "stands on the shoulders of giants". But over the last few decades, this process has been under constant threat through the processes of enclosure described by Boyle (2003). According to David Bollier, only a generation ago academic researchers regarded the patenting of discoveries as "a contemptible affront" to their mission of serving the public (2002, 135). To make his point, Bollier presents various examples of researchers that refused to patent either "their" discoveries or techniques, including John Salk, Albert Sabis and John Endes: the team that developed the polio vaccine. The argument is a simple one: any "breakthrough" is built on the hard fought successes and failures of previous researchers over centuries if not millennia.

This sharing of knowledge in an open, free and reciprocated environment has been described as "intellect"—which has been discussed elsewhere as a social (Lessig 2004) or cultural commons (Arvanitakis 2009). This is an exchange that has served the academic community over centuries and in opposition to this free and open exchange is the strict adherence to "Intellectual Property"—placing clear property rights around once open information.

The enforcement of property rights on what was once considered openly shared intellect can be traced back to the 1980s when the US Supreme Court in the 1980s to set a wide reaching precedent by granting the first patent on a living organism (Anderson 2000). While this was meant to create an environment to inspire researchers as it offered to safeguard their "discoveries", the unintended consequence was that it created a crisis of "scarcity" where once abundance existed (Westphal 2002). Such scarcity emerges because those who now own patents can demand payment if others use their intellect – often causing research-

ers to turn away from research areas where they fear they may breach established patents (ibid).

As noted, despite rhetoric that appropriate private property rights are required to promote research, the opposite often occurs (Westphal 2002; Arvanitakis and Boydell 2012). We are not saying that knowledge should not be attributed to the authors, researchers or artists, but rather that clearly defined property rights around 'intellect' limits the free and open exchange of knowledge and again, the benefits are concentrated in the hands of the very few – a conclusion well supported by much academic research over the last decade (Benkler 2006; Boyle 1996, 2003, 2008; Coombes 1998; Drahos 1997; Drahos and Braithwaite 2002; Gillespie 2007; Halbert 2005; Hemmungs Wirtén 2004; Lessig 1999, 2001, 2008; McLeod 2001; Vaidyanathan 2004).

This enclosure of the immaterial has not been limited to "intellect" and has had impacts on both an individual and communal level.[2] Individually, this results on an enclosure of our 'imagination' as we see no alternatives. On a community level, it creates sense of scarcity and an undeniable truth that the best way to manage resources is through the enforcement of private property rights. This is the materialisation of Foucault's (2003) triangle of power: an indisputable right encased in the knowledge of 'truth'. And like the enclosure of the lands and the institutional enclosure, this is accepted as both natural and normal—and like Verbal's Devil, we do not actually see it.

Whenever power is made visible, however, it provokes counter-power. As capitalisms' need for expanding markets pushes the processes of privatisation to new levels where genes, organisms and information are increasingly privatised as intellectual property, this also provokes resistance in a wider range of commons movements. The battle seems to stand between international commercial interests looking for new resources to commodity and different social movements trying to create commons safe from the mechanisms of capitalism. In the sections that follow, we focus on one such commons movement: the political pirate movement. This movement, we argue, makes visible processes of enclosure by challenging certain property rights through its ideology as well as its acts.. Such acts may potentially destabilise the very concept of property at the basis of neoliberalism and create new spaces of commons.

4. Property rights, piracy and disruption

The basis of all this enclosure is, as conservative commentators such as Helen Hughes (2004) remind us, that property without rights is economically useless. In this way, private property rights are framed within Foucault's triangle of power and presented as eternal and universal. Property rights, as we are repeatedly reminded from John Locke (1690/2000) to Garret Hardin (1968), and more recently Gollin (2008), is the source that drives innovation, promotes efficiency and protects scarce resources. Property rights, the argument follows, must be clearly defined to allow an individual to protect their economic output, and freely trade and profit from the energy of one's work.

Property rights, however, are neither easily defined nor universal. As Boydell et al (2009) have argued, when describing the complex nature of property rights as a constellation because they are always connected to an intricate web of both obligations and rights. The example drawn on is the (exciting) moment of purchasing your first car: though you may purchase the car that you have always dreamed about and it is 'your' property, you cannot do with this private property as you will. In this example, you must ensure the car is registered (in the Australian case this requires three different steps including compulsory third party insurance), is road worthy, and you must follow a myriad of road rules and regulations including wearing a seatbelt and following the speed limit or suffer the consequences. Again, in the context in which we are currently working, you must inform the relevant authorities if you move to a different residential address.

[2] For a detailed discussion of the enclosure of the 'cultural' commons of hope, trust, safety and intellect, see Arvanitakis (2007; 2009).

This is but a fraction of the intricate web of rights and responsibilities that Arnold (2002) describes and follows the 'ownership' of private property. In this way, even something as clear-cut as owning a car is enveloped in a constellation of rights and obligations associated with property rights. Further, these rights can be both formal and informal in nature: the legal requirements are also accompanied by social expectations that, in Australia, include waving and acknowledging someone if they make way for you.

As such, property rights are socially and culturally contextualised. They are not some universal truth—despite the denial of the Devil. This is highlighted in everything from the Open Source Software movement (Lessig 2008) to the cultural and spiritual association to "land" by Indigenous peoples across Australia, the United States, the Pacific and Scandinavia (Arvanitakis and Boydell 2012; Coq 2014). Property rights, as such, are continuously contested because of this tension: the myth of the universal truth comes into direct conflict with our lived reality and the way that they are constantly grounded within the socio-cultural context in which they operate.

This was further highlighted by the Global Financial Crisis, which created a crisis in private property rights that was raised into the public consciousness. This occurred as the private property ownership that had brought material wealth to small sections of the population had public links: quite simply, the financial crisis was the creation of private investment gone bad but had to be bailed out by public infrastructure (Varoufakis 2011). This was interlinked with the collapse of the financial sector where the clear delineation of who owns what—the very basis of capitalism—disintegrated as governments and the public were forced to bare the risks and the costs for the financial sector's private speculations—speculations that had wielded untold profits from publicly owned and funded resources (Johnstone et al 2010).

The financial crisis then, became deeply linked and centred on contestations over the definitions of property and commodity—who gains and who bares the costs. The concept of property rights was shown to be neither eternal nor universal: the Devil, after all, did exist and its failure brought misery to the lives of hundreds of millions as the global financial system sat on the brink of collapse.

It is from this position of contestation that we can also interpret acts of "piracy". Piracy is a disruption highlighting the many myths associated with property including the fiction that you can create clear, universal and uncontested property rights. Acts of piracy, be they the illegal copying of textbooks in India (Liang 2009) or the emergence of the Pirate Bay in Sweden, highlight the fragility of the global property rights regime.

If patents on genes and living organisms extend the boundaries of property, then the proliferation of file sharing questions the distinctions of property from the opposite perspective. When media corporations and copyright organisations argue that piracy is an act of theft that deprives the author of her or his lawful property, enclosure is seen to deprive the broader community of wealth commonly owned (Bollier 2002). And what we found in our research is that many pirates see file sharing as a free exchange of information and ideas that should not be enclosed. From their perspective, file sharing is an act of communication, and the information shared is a part of the intellectual commons. The file sharing debate is thus a direct conflict over the distinctions of property as it revolves around whether the resources at stake are part of the cultural commons or a market of commodities.

This conflict was fundamental for the politicisation of piracy that caught speed in 2006 as a response to the prosecution and trial against the globally (in)famous file sharing site The Pirate Bay. Among other things, this trial contributed strongly to the mobilisation of political "Pirate Parties", first in Sweden and then in many other parts of the world (Burkart 2014; Fredriksson 2014; Fredriksson 2015).

And it is from this perspective that we must understand why Pirate Parties and their associated activists rally to protect mechanisms that promote communication such as a free Internet. The value of communication constitutes a cornerstone for the Pirate Parties as they believe that digital technology can enable a new, more open, participatory and democratic public sphere. This public sphere is seen to be threatened by two forces that attempt to control the Internet. The first is the effort of the market to commodify communication as intellectual property. A member of the New York Pirate Party exemplifies how copyright can interfere

with the freedom of communication when he talks about how ideas and ideologies may spread between different protests movement, from the Euro-American open source movement, to the Arab spring and back to Occupy Wall Street and its spinoffs:

> […] these ideas spread in unpredictable manners and showed up in unpredictable ways which is why we are advocating a lack of intellectual property, because it's a barrier to ideas spreading and changing and mutating and morphing. And when you allow them to do that, wonderful things happen. (L. Brunner and Z. Adams Green, interview, April 2, 2012)

The second threat to this new public sphere is the increasing censorship and mass-surveillance that underpins the unending war on terrorism, where states violate the freedom and integrity of the digital public sphere in the name of protecting people and societies from a vague and undefined terrorist threat (Andrejevic 2007). Reflecting on the dictatorial history of his own country of birth, Germany, Markus Kesler describes how his work with the Oklahoma Pirate Party was largely motivated by a fear of authoritarianism that grows as the authorities turn to terrorism as the new pretext to increase their control of the citizens (M. Kesler, interview, March 10, 2012). In an e-mail conversation, Andrew Norton of the United States Pirate Party discusses how the threat of terrorism is used to instil a sense of fear that legitimises stricter surveillance:

> It's the major method used to restrict any sort of rights over the last ten years. And it's something that covers EVERYONE. Also, it's not a "War on Terror" […] It is, instead, a War *OF* Terror, quick literally using psychological methods and tricks to manipulate people into giving up rights for non-existent threats. (Norton, Private correspondence, February 3, 2012)

The Pirate Party's ambition to protect free speech and the access to free culture and information against restrictions imposed by the market and the state makes it an institutional political manifestation of the opposition against the enclosure of the intellect – that is, the privatisation and commodification of public discourse. For Andrew Norton, with a background both in European and American Pirate Parties, this is fundamental in the protection of the democratic values that are seen to be at the very core aspirations of contemporary western culture:

> In Europe there is still the 'hope of democracy'. In the US, it's only a few idealists that cling to the notion that there is a form of democracy and bother to 'waste our time' getting involved with US politics outside the rigid confines of the 'establishment'. (Interview with Andrew Norton, March 14, 2012)

Many pirates, both in the USA and Europe, blame this democratic deficit on the influence of money on politics. Norton for instance goes on to conclude that:

> If there was one thing that's been made clear in the US, it's that political power = money. For a 'Major Party' […] you're looking at 1-2 million for a house seat, and 15+ for a senate. Trying to get a 'minor party' candidate will require a LOT more' (Norton, Private correspondence, February 3, 2012)

As Lawrence Lessig points out in his 2011 book, *Republic Lost: How Money Corrupts Congress—and a Plan to Stop it*, this makes politicians heavily dependent on corporate sponsors. In a sense, this is an enclosure of the democratic political system—or what Taussing described in 2002 as the colonializing of politics (Taussing 2002). The democratic infrastructure, though far from perfect, is part of the commonwealth inherited from previous generations—and the threat of its enclosure is laid bare by Pirate Parties.

This makes the Pirate Party appear more or less as a utopian movement. When Orion Steele from the Californian Pirate Party is asked if he sees the Pirate Party as a utopian par-

ty he immediately confirms: ”Is the pirate Party utopian. Yes! And that is awesome and no political party should NOT be utopian”. This is not unique to the Pirate Party, but it may be significant for third parties:

> There is something unique about all third parties in America. That sense of fatalism because of the two party system and the way that our campaign finance and the way that our campaign laws are set up. If you’re willing to jump into a third party, there’s gotta be some kind of utopianism in there. (Interview with Orion Steel, 5 January 2013)

5. New spaces of piracy

At the same time the modes of enclosure are always changing, as new kinds of resources are being commodified and exploited. Some scholars are pointing to the emergence of big data and cloud storage as an expression of an “enclosure 3.0” (Lametti 2012) or a “digital enclosure” (Andrejevic 2007). Although the terms may differ, the concerns raised focus on a new phase in the commodification of information where the dominant business strategy is on the extraction and exploitation of user data.

According to Peter Jakobsson (2012), this is part of a new ‘openness industry’ represented by companies like Google, that is antagonistic towards the copyright industry as intellectual property limits the circulation of free content that is essential to their business model. This is in line with Hardt and Negri’s dialectical understanding of the relationship between the commons and the market where the market relies on expanding commons to commodify.

Likewise, the openness industry thrives on the exploitation of resources that are not enclosed as intellectual property (Jakobsson 2012; Jakobsson and Stiernstedt 2012). The price that the consumers pay for this abundance of seemingly free culture and information is excessive data mining where private user data becomes a commodity. This creates a new information economy where we can, as Ned Rossitter and Soenke Zehle put it, argue that “Privacy is Theft”:

> Anonymity registers the possibilities for both individual and collective refusal to turn our communicative relations into generators expected to power the data driven enterprises of an experience economy. The result, in effect, is a withdrawal of ‘free labour’ from the institutional settings of a digital economy, its clouds and communication platforms. (2014, 346)

So, the seemingly abundant access to information that the openness industry offers is an illusion of transparency that hides the devil in the cloud. By giving everything freely to the consumer it hides the basic act of exploitation where the users are made to work for free for those who control the means of exchange in the information society. Returning to Foucault, the cloud is simply a privatization of digitally enhanced biopower where collective human behaviour is aggregated into statistics and demographic data appropriated by state bureaucracies, or in this case commercial actors, to predict and manipulate the masses (Foucault 1990).

Though we are discussing a contemporary technology, the historical roots are much deeper and can be linked to the relationship between primitive accumulation and the commons (Glassman 2006). Here the information commons is a new challenge to the ‘separation’ of worker from their labour and therefore become a target of enclosure. It is here that we can see piracy as a way of reclaiming the commons and in so doing, reclaiming the relationship between one’s relationship to their labour.

It is here that acts of piracy may not be just reactive but proactive in establishing new commons. As Balász Bodó (2014) highlights in his research on file sharing, (pirate) communities often promote ‘voluntary’ property rights regimes. In his detailed case study, Bodó demonstrates the diversity of closed and often very specialised file-sharing piracy networks that exist beyond mainstream platforms and concludes that alternative networks can impose their own rules of exchange which can be more efficient than any formal and universal system of property rights.

Importantly, the rules of exchange are negotiated within the specific context. This returns us back to the arguments proposed by Ostrom (1990; 2010). For Ostrom, what is required are governance structures and institutional commons that are contextual. Such arrangements encourage adaptation to changing circumstances, as well as building in systems that allow communities to address previous errors and new developments.

Ostrom argues that under such circumstances, access to resources is not necessarily free, as common-pool resources are not public goods. But as Bodó finds, any costs should not exclude appropriate use. Communities monitor access to the resource and can actually make a decision to make accessibility more difficult

This is not to argue that Ostrom's proposals is a panacea for solving all challenges. In fact, rather than offering a simple solution, Ostrom herself acknowledges the limitations of a one-size fits all approach such as the imposing of full private property rights (Ostrom 2010, 182). It is here that we can turn to Bodó's concluding argument: that piracy can construct its own efficient property regimes. Unfortunately, such regimes can both establish new commons or create their own artificial systems of scarcity.

6. Conclusion

In concluding, it is important for us to emphasise that we do not necessarily see piracy as a revolutionary moment, though it has been described as such by some pirate party activists and scholars (Özdemirci 2014); nor is piracy merely mundane and everyday, though such a description has been used by others (see Da Rimini and Marshall 2014; Andersson 2014). Piracy, as an act or an ideology, may not present a solution to all processes of enclosure, but it has an ability to articulate enclosure as a practical and political problem by showing how it interferes with people's everyday life and how it can be ideologically challenged (Fredriksson 2012, 2014, 2015). Piracy can, as we have argued, also establish alternative exchange mechanisms.

Regardless of exactly where an act of piracy falls along this spectrum—be it revolutionary or mundane—it highlights the myth of clearly defined property rights as well their contextual nature. As a revolutionary act to confront property rights that ruptures the neoliberal ideology, piracy presents us with alternative property rights regimes including the re-establishment of the commons. As a mundane act of the everyday consumer, it confirms that the universal truth claims of property rights are continuously questioned.

We see this in the straights of Somalia as the property rights of the shipping lanes are not respected nor can they properly be protected; in every piece of music that exists or movie made, book published, the potential for piracy emerges and, as such, highlights the precarious nature of the universal property rights regime.

Just how the concept of piracy can be expanded to challenge a wider range of property rights is highlighted by researchers such as Ravi Sundaram (2010) who explores the way piracy is intertwined with unauthorized use of urban space in third world cities. Sundaram, along with Lawrance Liang (2005), identify the prevalence of pirated products in the ungovernable slums and shantytowns of Delhi. Their research explores parallels between the distribution of pirated software, films and books and the various practices that provide illegal access to public spaces such as squatting and the creation of new commons. The universal myth, like the Devil, is again exposed.

This process represents a complex interplay, however, as neoliberalism uses the breakthroughs generated by piracy and the creation of new commons as a way to further enclose and commodify an expanding range of resources. Hardt and Negri (2004) have discussed the ambiguous and intimate relation between capitalism and the commons, where capitalism is inherently reliant on the commons to produce new commodifiable resources to ensure the constant growth of the market. This creates an irony: acts of piracy break down the very property rights that are meant to promote innovation, but are often at the same time highly creative and then become the subject of enclosure. And it is here we find both the potential and the threat to the new commons movement (Arvanitakis 2007).

This 'exposure' of the fragility of property rights regimes is also repeatedly being highlighted by acts of piracy. Piracy, in this way, emphasises both the contextualised nature of property rights regimes, as well as the possibilities of alternative systems of rights. As an alternative to legal services like Spotify and open torrent trackers like The Pirate Bay, infested with data mining or pornography, many consumers turn to various specialised file-sharing communities that are often very exclusive in their selection of members. As noted, Balász Bodó (2014) has highlighted that such file-sharing (pirate) communities often promote 'voluntary' property rights regimes. Here we see the diversity of closed and often very specialised file-sharing piracy networks that exist beyond mainstream platforms and concludes that alternative networks can impose their own rules of exchange which can be much more efficient than any formal and universal system of property rights. Piracy can thus, in some cases, construct and impose its own property regimes and artificial systems of scarcity.

In the final scene of *The Usual Suspects*, the Devil (so to speak) is exposed. We understand that the context in which "he" has been operating is one of deception, hiding in plain sight of those that are looking for him. Property rights are much the same: despite claims of universal truth, the recent global financial crisis has highlighted that they are fragile as many governments had to confront the consequences that followed from turning private enterprises into public risks decades earlier. Piracy highlights the very same fragility, but from the opposite perspective: it threatens to turn private property into public resources.

Piracy, as such, is not free from norms and gatekeepers, nor is it always free of charge. But what the work of Bodó, Liang and Sundaram emphasise, is that piracy produces contextualised understanding of property rights. The politicisation of piracy that organisations like the Pirate Party represent further highlight the potentials of piracy to destabilise a neoliberal understanding of property as a cornerstone of creativity. And as such, piracy has the potential to rupture Foucault's triangle of power and in so doing so, expose the true nature of the Devil.

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Following the Open Source Trail Outside the Digital World: Open Source Applications in Agricultural Research and Development

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Abstract: In this article, we assess the application of the open source development model in the field of agricultural research and development, as a potential tool for upholding both public scientific research, and farmer-led innovation and farmers' rights. First, we provide an overview of the problems associated with the rise of IPRs in agriculture in view of global challenges such as food security and environmental sustainability, and present the debate on farmers' rights, including its rationale and international policy and legal responses. We then review open-source initiatives in the digital domain, including successes and shortcomings, and offer our understanding of relevant terminologies. We explore the parallels between software development and innovation in agriculture, review ongoing open source agriculture-related initiatives, and identify lessons learnt. We particularly assess the potential for open source systems to address existing asymmetries in capabilities and contribute to global challenges such as food security.

Keywords: free software, open source, farmers' rights, research and development, intellectual property rights, patents, plant breeders rights, copyright, copyleft, food security, agricultural biodiversity, innovation

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Intellectual property is neither - The Anarchist in the Library, by Siva Vaidhyanathan

Knowledge sharing has been common practice throughout human history, and the exchange and remix of cooking recipes serves as a notable example. But also at the start of the food production process, farmers have been exchanging seeds and agricultural knowledge for centuries. Until recently, agricultural innovation was farmer-led, and depended upon open systems aiming to ensure both the sustainability and adaptability of production and the conservation of agricultural biodiversity—a term which refers to the outcome of interactions among genetic resources (the seed), the environment (the surrounding ecosystems), and farmers' management systems and practices (the knowledge) (Tsioumani 2014, 4). In this context, the seed integrates the tangible with the intangible.

The modernization of agriculture and the green revolution dramatically increased world food production through scientific and technological advances, including modern plant breeding. The professionalization of breeding and the emergence of the commercial seed sector however resulted in both the erosion of agricultural biodiversity, due to the uniformisation

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promoted by the dominance of commercial varieties, and the marginalization or, in cases, criminalization of customary farmer practices, in favour of corporate-led research supported by intellectual property rights (IPRs). The vast expansion of intellectual property protection in the field of biotechnology in particular has led to concerns that innovation will be blocked unless action is taken to preserve access to and create additional tools to enable further research and development (Hope 2004).

In this article, we assess the application of the open source development model in the field of agricultural research and development, as a potential tool for upholding both public scientific research, and farmer-led innovation and farmers' rights. First, we provide an overview of the problems associated with the rise of IPRs in agriculture in view of global challenges such as food security and environmental sustainability, and present the debate on farmers' rights, including its rationale and international policy and legal responses. We then review open source initiatives in the digital domain, including successes and shortcomings, and offer our understanding of relevant terminologies. We explore the parallels between software development and innovation in agriculture, review ongoing open source agriculture-related initiatives, and identify lessons learnt. We particularly assess the potential for open source systems to address existing asymmetries in capabilities and contribute to global challenges such as food security.

1. The Rise of IPRs in Agriculture

IPRs are supposed to foster and reward creativity and innovation by protecting inventions of the mind. There are several different types of IPRs, and their use depends on the invention at stake. In the field of agricultural development, the types of IPRs that are mainly in use are plant breeders' rights and patents.

Historically the first to appear, in association with the emergence of scientific plant breeding at the times of the green revolution in the 1960s, plant breeders' rights are a common type of IPR protecting plant varieties. They were established by the 1961 International Convention for the Protection of New Varieties of Plants (UPOV Convention), which promoted a system of private ownership 'with the aim of encouraging the development of new varieties of plants for the benefit of society' (UPOV mission statement). Standards adopted under the UPOV Convention, which was amended in 1972, 1978, and 1991, provide protection to novel (in terms of prior commercialization) and distinct, uniform and stable plant varieties.

As a result of the novelty requirement of intellectual property protection, farmers' varieties have been regarded as 'prior art' within the public domain. In addition, farmers' varieties are neither uniform nor stable, thus they cannot satisfy the UPOV criteria for protection. This asymmetry between scientific and farmer-developed varieties has led to widely-perceived unfairness, particularly among smallholder farmers in developing countries, a perception also shared by their governments: their varieties could be acquired and shared freely and could be used in the development of modern varieties, which would then be protected by exclusive property rights. Finally, a series of famous biopiracy cases involved the granting of patents on hardly invented or novel plant varieties and traditional uses that were previously in the public domain (CIPR 2002).

At least, the model of plant breeders' rights as epitomized by the 1978 version of the UPOV Convention clearly permitted the use of protected varieties as the source material of further breeding (breeders' exception) and the re-use of saved seeds by farmers (farmers' privilege) (Correa 1999, 3). Both are important mechanisms to protect farmers' livelihoods, allow for farmer-led innovation based on traditional seed-saving and exchange practices and in general guarantee the continued exchange of material for public research and global food security purposes. These exceptions however were restricted in the latest revision of the UPOV Convention in 1991. The plant breeders' exemption was preserved; acts done "privately and for non-commercial purposes" or "for experimental purposes" were also exempted; but the farmers' privilege for replanting was restricted; while the scope of protection was extended beyond the propagating material of protected varieties to include "essentially derived varieties". According to this amendment, farmers were required to limit the amount of

saved seeds or to pay an equitable remuneration to the right holder. In addition, use of protected varieties by farmers is permitted only for propagating and planting on their own holdings, but not for informal sale, thus also restricting exchanges among farmers (Chiarolla et al. 2013, 85).

UPOV membership was boosted with the adoption of the Agreement on Trade-related Aspects of Intellectual Property Rights (TRIPS Agreement) under the auspices of the World Trade Organization (WTO) in 1994, as WTO Member States are required to provide for the protection of plant varieties either by patents or by an effective sui generis system (TRIPS Agreement Article 27.3b). Although, according to the latter option, countries are free to identify a system to suit their particular agricultural and socioeconomic conditions, the UPOV Convention provides a ready-made sui generis framework, and therefore appears as an obviously easy choice. Developing country membership is thus constantly increasing, despite the fact that the UPOV system is tailored to the needs of the commercial seed sector and the commercialized farming systems of the developed countries rather than the subsistence agriculture of the developing ones (Yamin 2003; CIPR 2002).

Exceptions aiming to protect farmers' and breeders' activities are usually even more limited under patent law. Patents provide the strongest form of intellectual property protection, in the sense that they normally allow the patent holder to exercise the greatest control over the use of patented material. Protecting plant-derived innovations under patent regimes requires an applicant to demonstrate novelty, an inventive step, and the potential for industrial application. At the moment, to the authors' knowledge, patents on conventional plant varieties are only allowed in the United States, Japan and Australia (Chiarolla 2012, 62–63; CAMBIA PatentLens). With the breakthrough of modern biotechnology in the 1990s however, the patent subject matter expanded dramatically, with an ever-increasing number of patents to cover not only transgenic plants but also particular plant traits and parts, components such as genes, plant breeding methodologies, and vectors and processes involved in the production of transgenic plants (Aoki 2009, 2296). Geographical application also expanded, as transgenic plants became patentable in Europe under the terms of the Directive 98/44/EC on the legal protection of biotechnological inventions.

Some examples can usefully illustrate the breadth of patents currently granted: In February 2010, US-based company Mendel Biotechnology won a patent in the US on plant transcriptional regulators, a class of genes that control the degree to which other genes in a cell are activated. These genes reportedly confer improved stress tolerance in genetically engineered plants, not for a single abiotic stress, but for drought, shade and low nitrogen conditions, and extend to virtually any transgenic plant and seed encoding a specified DNA sequence. BASF US patent on "transcription factor stress-related proteins and methods of use in plants" lays claim to transgenic plants transformed with isolated DNA sequences that confer increased tolerance to environmental stress, including salinity, drought and temperature, and covers virtually all flowering plants, such as maize, wheat, rice, soybean, potato and tomato, to mention only some. Monsanto's international patent application, published by the World Intellectual Property Organization (WIPO) in February 2010, describes novel proteins derived from bacterial cold shock proteins, which, upon expression in transgenic plants, provide the plants with enhanced stress tolerance to heat, salt and drought (WIPO Patentscope). The application makes extremely broad claims, not just to the modified plant cells that exhibit improved stress tolerance but also the processed product derived from the transgenic plant. All these extremely broad patents refer to plant components and processes which could be relevant for adapting agricultural research and production to the challenges of climate change (ETC Group, 2010).

1.1. IPRs, Concentration and the Impossibility to Innovate

The rise in the number and breadth of patent claims is indicative of the radical shift from farmer-led, user-based innovation and public agricultural research to mass-market, seller-based innovation and corporate research (Aoki 2009, 2277). IPR systems, crafted around models of industrialized agriculture, discourage research on unprofitable subsistence crops

in favour of high-earning crops destined for developed world markets; and create multiple obstacles to both public breeders and farmers, as it is further explored below.

Furthermore, while the number of patent applications is increasing annually in both the US and Europe, the number of applicants is decreasing. Dozens of mergers, acquisitions and strategic alliances since the 80s have resulted in a dramatic concentration of control in a handful of companies, sparking concerns regarding undue control of global food production, privatization of agricultural research and as a result, risks for food security. The degree of concentration in the agrochemical sector is described in the literature as "dramatic," leading to a "pervasive restructuring" of the plant breeding sector (Aoki 2009, 2297). According to ETC Group, the top ten seed companies account for 67% of the global proprietary seed market; the world's largest seed company alone, Monsanto, accounts for 23% of that market; and the top three companies (Monsanto, DuPont and Syngenta) for 47% (ETC Group 2010). The risks associated with this trend have been addressed also by the UN Special Rapporteur on the Right to Food (UN Special Rapporteur on the Right to Food 2009, 2010). In addition, a handful of big firms own most key enabling technologies. Ownership of patents on enabling technologies enhances their market power, ties smaller companies to them, and also acts as a barrier to market entry (Hope 2004).

Literature suggests that the two phenomena of patent expansion and market concentration might be more tightly linked than one thinks. Janet Hope for instance argues that the "merger-mania" has been driven primarily by the need to avoid high transaction costs associated with clearing multiple IPRs (Hope 2004). The combination of broad patents with market concentration has a number of additional consequences: first, at least in the US where the phenomena are more intense, it means that the legal framework can be lobbied to change. Enforcement of IPRs is not even needed, as competing companies and varieties are virtually absent and "the dominant oligopolists are in a position to dictate to farmers the very conditions of access to seed" (Kloppenburg 2014, 1229).

Second, researching and negotiating the IPRs that potentially surround the material and methods of their work in order to obtain "freedom to operate" is a substantial transaction cost for breeders (Kloppenburg 2014, 1230). An often-cited example in this regard is that of Golden RiceTM, a genetically modified rice variety heralded as a potential solution to vitamin A deficiency (Aoki 2009, 2297). A detailed analysis of the intellectual property dimensions documented approximately 70 patents and pending patent applications implicated in its development. The high media profile of the case facilitated negotiations with the patent holders. Humanitarian-use licensing was applied, an otherwise rarely used tool, which allows for humanitarian uses of proprietary technologies to support international development objectives.

Navigating the patent landscape is further complicated by the uncertainty generated by those patent applications that are still pending, resulting in an inability to even locate the ownership of patents for key enabling technologies (Hope 2004), as well as by the fees usually required for searching patent databases. The obscurity is further exacerbated by the fact that, while ownership of the patent is usually a matter of public record, ownership of the rights transferred through licenses is not. Most jurisdictions do not impose a responsibility on licensees to disclose, making it almost impossible for a researcher to assemble all the licenses needed to proceed with her research (Jefferson 2006).

This multi-level complexity has devastating consequences for public breeders, particularly in developing countries, who would wish to invest in research on undervalued crops relevant for local food security. In a clear inversion of the intent of IPR legislation, monopoly power is used to obstruct research and impede innovation: in the possibility only of patents and pending patent applications on material and methods they may use, breeders are advised not to proceed with their work out of fear of litigation and the cost involved, even if the patent claims are likely not defensible in court (Kloppenburg 2014).

The effects of the widespread patenting of germplasm, research technologies and breeding methods have been characterized as a "tragedy of the anticommons" (Heller 1998; Heller and Eisenberg 1998). Heller's tragedy of the anticommons mirrors Hardin's tragedy of the commons, where a resource is prematurely exhausted because no one has the right to exclude (Hardin 1968). In contrast, the tragedy of the anticommons refers to a situation where

too many parties hold a right to exclude with respect to a particular property or resource, meaning that several permissions must be obtained for use, due to overlapping ownership claims. As a result, public breeders' innovation is obstructed and agricultural biodiversity is threatened. Unlike other natural resources such as forest and marine resources, conservation of agricultural biodiversity is performed through use: unless an agricultural variety is used, it cannot be conserved for more than a few decades before it eventually dies (Tsioumani 2014). Threats to agricultural biodiversity are exacerbated by the effects of IPRs on farmer innovation, which are briefly addressed in the following section.

1.2. IPRs and Farmers' Rights

In the meanwhile, as previously noted, farming communities around the world have been developing traditional crop varieties for centuries. As a subsistence strategy, they have maintained a high genetic diversity of plants and animals, as well as different location-specific bodies of traditional knowledge and farming practices. In these local seed systems, the primary emphasis is not on high yields and productivity, but on resilience and risk-adverse qualities in the face of harsh, variable and unpredictable conditions. Traditional varieties therefore serve as reservoirs of agricultural biodiversity, providing a much required safety valve in the face of threats such as pests, diseases and environmental stresses. They also form the basis of local and global food security: according to the UN Special Rapporteur on the Right to Food, over 70% of the world's food production relies on smallholder farmers (OHCHR 2014). In addition, as modern varieties often rely on the traits of traditional ones, traditional varieties and the traditional knowledge they embody are considered vital resources also for scientific agricultural research.

Traditional varieties cannot be protected by the formal intellectual property system. Their role and importance is recognized by environment-related international conventions, mainly the International Treaty on Plant Genetic Resources for Food and Agriculture (ITPGR) and the Convention on Biological Diversity (CBD). In these fora, farmers' contribution to agricultural biodiversity and global food security is generally acknowledged, along with the realization that their practices and knowledge should be supported. Two intertwined legal concepts were developed in this regard: fair and equitable benefit-sharing, and farmers' rights.

The CBD, adopted in 1992, established the principle of national sovereignty over natural and genetic resources. In the words of M. Halewood et al, 'if developed countries were able to exercise restrictive control over advanced biologically based technologies using intellectual property rights, developing countries could exercise their sovereign rights to regulate and restrict access to the biological and genetic resources within their borders' (Halewood et al 2013, 6). Adoption of the CBD reflected developing countries' efforts to react to the injustices embedded in the IPR system, as well as their expectation to share in the gains of the emerging markets for biodiversity-based products. The tool envisioned to support these goals was the legal notion of fair and equitable sharing of benefits arising from the use of genetic resources, which features prominently as one of the three CBD objectives, alongside conservation and sustainable use of biodiversity. Fair and equitable benefit-sharing has thus a central position in all the programmes of work and other soft-law instruments developed under the CBD, including the ones on agricultural biodiversity, as well as in the recently entered into force Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (Tsioumani 2014). Benefits to be shared may include monetary or non-monetary ones. The sharing of experiences and the transfer of knowledge and technologies for instance are recognized in the CBD programme of work on agricultural biodiversity as specific forms of benefit-sharing (CBD Decision V/5). No specifications are offered, however, with regard to the obstacles posed by IPRs to the transfer of knowledge and technologies.

The ITPGR, negotiated under the auspices of the UN Food and Agriculture Organization (FAO), is the first legally-binding instrument to introduce the concept of farmers' rights. Farmers' rights emerged as a reaction to the asymmetry between farmers as donors of germplasm in the form of open-access traditional seeds/propagating material and the pro-

ducers of commercial varieties that ultimately rely on such germplasm. While commercial varieties were protected and generated returns on the basis of plant breeders' rights, there was no system of compensation, reward or incentive for the providers of traditional germplasm. At the same time, farmers' rights were meant to ensure that the restrictions in use associated with IPRs would not adversely affect farmers' practices. That means that farmers should not only be allowed to continue, but also encouraged and supported in their contribution to the maintenance and development of plant genetic resources and food security globally (Andersen 2005, Correa 2000).

The ITPGR recognizes farmers' rights as collective rights, and acknowledges the 'enormous contribution that the local and indigenous communities and farmers of all regions of the world, particularly those in the centres of origin and crop diversity, have made and will continue to make for the conservation and development of plant genetic resources which constitute the basis of food and agriculture production throughout the world'. Leaving the matter of implementation to national governments, the ITPGR does not provide a definition of farmers' rights, but sets out measures a Party should take to protect and promote them, including: the protection of traditional knowledge; the right to equitably participate in sharing benefits arising from the utilization of plant genetic resources for food and agriculture; and the right to participate in decision-making at the national level on related matters (ITPGR Article 9). In addition, it reaches no final conclusion with regard to the link between farmers' rights and IPRs. Instead, it states that 'nothing in this Article shall be interpreted to limit any rights that farmers have to save, use, exchange and sell farm-saved seed/propagating material, subject to national law and as appropriate.' It does not, therefore, limit the customary rights of farmers to reuse, exchange or sell farm-saved seeds. Nor, however, does it safeguard these rights by establishing an international legal basis for their protection against IPRs. An acknowledgement of the need for farmers to access seed and be enabled to continue with their informal practices has come from the UN Special Rapporteur on the Right to Food. He has noted that human rights obligations in relation to the right to food imply that the commercial seed system needs to be regulated in order to ensure that farmers have access to inputs, including non-open-access seeds 'on reasonable conditions'; and that innovations leading to improved varieties and resources benefit all farmers, including the most vulnerable and marginalized ones. At the same time, States should ensure that informal, non-commercial seed systems can develop and be protected from interference and pressures imposed by the commercial seed sector (UN Special Rapporteur on the Right to Food 2009, 4).

The following question illustrates the clash between IPRs and farmers' rights: is a farmer allowed to save, exchange and re-use seed that incorporates an IPR-protected component? The possibility that farmers save seeds for further use has been a typical feature under plant variety protection, but it has been restricted under UPOV 1991 and is generally not provided for under patent laws. It can be argued that in the context of the entire spectrum of their international legal obligations, IPR-, biodiversity- and human rights-related, national governments may opt for supporting farmers' rights against the interests of corporations, through national legislation. National positions may vary. Jurisprudence in US and Canadian courts has affirmed the primacy of patent rights over the right of the physical owner of the seed to save and replant (Monsanto Canada Inc. v. Percy Schmeiser 2004, Bowman v. Monsanto Co 2013). India's 2001 Act on Protection of Plant Varieties and Farmers' Rights, on the other hand, establishes rights for farmers to save, use, exchange and sell farm-saved seed, conferring also related rights to breeders and researchers (Farmers' Rights Project 2009). A member of the WTO and the TRIPS Agreement, India considered its legislation to be in compliance with TRIPS provisions on plant variety protection, and applied for UPOV membership. The Act however was found not in compliance with the UPOV requirements and now, more than ten years later, India's UPOV application is still pending (Farmers' Rights Project 2009, UPOV Aug. 2015).

The tension between IPR rules and those related to the protection of agricultural biodiversity and farmers' rights is further illustrated by (currently negotiated, but mostly stalled) proposal to amend the TRIPS Agreement to make it consistent with the CBD, through disclosure of evidence of prior informed consent and benefit-sharing in patent applications. Those nego-

tiations could reconcile the two systems, but are nowhere near completion. In the meanwhile, unlike the CBD and the ITPGR, enforcement of the TRIPS Agreement is linked to WTO's dispute settlement system and its rules are backed up by the threat of retaliatory sanctions (Aoki 2009, 2287). No case involving national implementation of farmers' rights, such as India's legislation, has reached the WTO dispute settlement system yet, but of course the convincing power of this threat for legislators around the world is significant. At the farmers' level, on the other hand, IPRs are easily enforced through contract law: Monsanto's "shrink-wrap" license for instance accompanies each bag of seed sold: opening the bag constitutes agreement to the terms of the license, which include, at length and explicitly, the obligation not to save or replant seed or hold Monsanto accountable for any form of liability. According to these terms, the farmer does not become the owner of the seed, but simply gets a license to use it (Kloppenburg 2014).

This brief examination of the international legal framework shows that the contribution of farmers to food security and conservation of agricultural biodiversity has been acknowledged, at least in the realm of international environmental law, and legal concepts have been developed to reflect this recognition. However, the complexity of the legal framework, the unclear relationship between international environmental and international IP law, and lack of enforceability of international environmental law, in combination with the power of the commercial seed sector, put both farmers and national governments wishing to protect farmers' rights in a vulnerable position. In addition, patent expansion and market concentration, as well as funding constraints, put public agricultural research at risk. The questions thus remain. How can farmers' and public researchers' contribution to global food security be supported? And how can it be defended against the obstacles posed by IPRs and other tools of the commercial seed sector? Looking for imaginative solutions, certain initiatives have started experimenting with novel tools inspired from developments in the IT sector, including open source seeds and technologies.

2. Terminologies

A number of conceptual and terminological clarifications are in order at this stage, regarding the meaning and operationalization of the term "open" in multiple contexts and the relationship of "open" concepts with the public domain and the commons (Louafi and Welch 2014). The commons is not the same as the public domain. Successful commons are frequently characterized by a variety of restraints, usually informal or collectively constituted (Boyle 2003). Their success and sustainability depends largely on skilled decision-making and cooperative management strategies (Hess and Ostrom 2007). Knowledge commons specifically refer to various types and regimes of information and knowledge managed collectively by a community of users. Enclosure, via privatization, commodification or withdrawal of information, is a key risk for knowledge (Boyle 2003), and the development and study of knowledge commons may be considered a response to this trend (Hess and Ostrom 2007).

The specific context of our research concerns resources, which are non-rivalrous (knowledge) and renewable (plant genetic resources). In economic theory, a good is non-rivalrous (or non-subtractive) when use by one individual does not reduce the benefits available to another (Hess and Ostrom 2007). This is obviously the case for knowledge, but also for plant genetic resources, which are self-replicating, and thus renewable. Plant genetic resources therefore, a natural but also human-made resource, do not have a key characteristic of other shared natural resources, such as fisheries: subtractability. Most types of knowledge, on the other hand, are non-subtractive. In fact, in the words of Hess and Ostrom, "the more people who share useful knowledge, the greater the common good" (Hess and Ostrom 2007). The same goes for plant genetic resources: the more they are shared, the better for food security and conservation of agricultural biodiversity.

Open systems have generally been associated with the practice of science and academia. These "open science" systems facilitate knowledge production through disclosure, sharing and reciprocal exchange, while they rely on a system of public expenditures (Louafi and Welch 2014).

In the current increasingly proprietary environment for material and non-material resources of scientific significance (Benkler 1999; Boyle 2003), the open access movement promotes public sector values by the removal of access barriers to academic research. In synthesizing a wealth of relevant literature, Louafi and Welch usefully argue that the open access movement represents a political response, seeking to democratize access to knowledge and innovation; it has been expanded by more recent open data initiatives, which refer more specifically to data and information that can be used for research purposes. Open source, on the other hand, refers to an economic response to information enclosures, and proposes an alternative model aiming to implement and manage open systems, in order to enhance production and innovation. Open source is thus more tightly linked with "legal and organizational rules meant to control behavior and outcomes" (Louafi and Welch 2014, 149). In this context therefore, open access systems and concepts are closer to the idea of the public domain, in the sense that nobody is excluded from use; while open source models are closer to the concept of protected commons, as they are open to a group of users and specific rules of access and sharing, including restrictions, apply (Louafi and Welch 2014). Similarly, while open access efforts maintain a flexible approach to the systemic inclusion of IPRs, open source relies on IPRs and licensing terms to establish and operationalize open systems.

3. Open Source in the Digital World

This section provides a brief description of the birth of the open source model and its relation with IPRs.

Although open source has generally been connected to the development of the internet, a notable contemporary example that predates the internet, is the Selden automotive engine patent case. After Henry Ford successfully challenged the patent, a new association, the Association of Licensed Automobile Manufacturers was formed. The new association instituted a cross-licensing agreement among all US auto manufacturers: although each company would develop technology and file patents, these patents were shared openly and without the exchange of money among all the manufacturers. By the time the US entered World War II, 92 Ford patents and 515 patents from other companies were being shared among these manufacturers, without any exchange of money (or lawsuits) (Flink 1977).

In computers, where software was initially produced mainly by academia, openness had long been established and software was distributed freely under the principle of cooperation. To further collaboration and research, the source code - the human readable version of a program - was also distributed for free.

By the late 60s, software started becoming more complex and production costs started increasing. This lead to increasing commercialization and subsequently, restrictions upon redistribution were imposed. By the early 80s, charging for software licenses had become mainstream and copyrights and trademarks were being widely enforced (Weber 2004). In addition, to prevent software from being used on their competitors' computers, most manufacturers stopped distributing the source code and began using copyright and restrictive software licenses to limit or prohibit copying and redistribution. This shift in the legal characteristics of software can be regarded as a consequence triggered by the US 1976 Copyright Act (Cringely 2005).

While many online communities were still building and sharing software, in 1983 Richard Stallman published the GNU Manifesto and started actively defending knowledge-sharing practices against the rise of software as a commodity. The GNU Project that was launched simultaneously had the goal of creating an open source operating system. Two years later, Stallman created the Free Software Foundation to support the movement. The philosophy of the free software movement is that the use of computers should not prevent people from cooperating with each other. In practice, this means rejecting "proprietary software", which imposes such restrictions, and promoting free software (Stallman 2004). According to Stallman and contrary to the IPR philosophy, this action will promote rather than hinder the progression of technology, since "it means that much wasteful duplication of system program-

ming effort will be avoided. This effort can go instead into advancing the state of the art" (Stallman 1985).

To protect the result of the work of free software communities and the GNU Project, Stallman published the GNU General Public License (GPL) in 1989. The GPL is the most widely used free software license (Black Duck Software 2015), which guarantees end users (individuals, organizations, companies) the freedom to run, study, share (copy), and modify the software. The GPL is a copyleft license, which means that derived works can only be distributed under the same license terms.

The free software movement harbours no good feeling for IPRs. They deem the term as overgeneralized, as it includes at least three different sets of rights (copyrights, trademarks, patents) and a few dozen unrelated ones under one umbrella. According to Stallman "the term carries a bias that is not hard to see: it suggests thinking about copyright, patents and trademarks by analogy with property rights for physical objects" (Stallman 2006). Along the same line of thought, economists Boldrin and Levine prefer the term "intellectual monopoly" as a more appropriate and clear definition of the concept, which they argue, is very dissimilar from property rights (Boldrin and Levine 2005).

As evident by the existence and content of the manifesto, the free software movement was a political response to the diminishing freedoms of computer users. But there were many members of sharing communities that did not share Stallman's vision. They touted technological superiority, innovation and economic growth as reasons for supporting sharing practices in software. Distancing themselves from the notions that non-free software is a social problem or unethical, members of the free software movement founded the Open Source Initiative in 1998.

The "open source" label was created at a strategy session held on 3 February 1998 in Palo Alto, California, shortly after the announcement of the release of the Netscape source code. The strategy session grew from a realization that the attention around the Netscape announcement had created an opportunity to educate and advocate for the superiority of an open development process. Participants believed that the pragmatic, business-case grounds that had motivated Netscape to release their code illustrated a valuable way to engage with potential software users and developers, and convince them to create and improve source code by participating in an engaged community. They also believed that it would be useful to have a single label that identified this approach and distinguished it from the philosophically- and politically-focused label "free software" (Open Source Initiative 2012). Currently, the term Free and Open Source Software (FOSS) is commonly used to include both software practices; and FOSS plays a key role in most software markets (Moody 2015).

FOSS is produced and distributed either by informal communities and non-profit organizations or as commercial products by corporations. Arguably the most publicly recognized project is the Linux kernel and the GNU/Linux operating system (OS). While Linux-based OSs hold a small market share in desktop environments, in web servers it controls the market (W3Techs 2015)(W3Techs 2015b). On the mobile front, Android, an open source OS running a modified version of the Linux kernel, is running on 96.3% of all smartphones. (IDC 2015) Apache, has been leading the web servers market for the last 20 years and with ngnix, another popular open source web server, attribute to more than half of the market (Netcraft 2014). At the client side of the web, open source browsers like Firefox and Google Chrome hold more than 60%. Despite the free vs open source schism, the overwhelming majority of OSI-approved licenses and self-avowed open source programmes are also compatible with the free software modalities and vice versa.

3.1. Assessing Effectiveness Against Patent Laws

Today, patent laws mainly threaten free software communities. A patent serves as a blanket injunction against implementing a certain idea. It does not matter who writes the code, not which programming language is used. Once someone has accused a free software project of infringing a patent, in the face of uncertainty and fear of litigation, the project must either stop implementing that particular feature, or expose the project and its users to expensive and

time-consuming lawsuits (Fogel 2015). Although companies using open source software can largely protect themselves by sharing patents, submitting new patents and battling patent litigation is extremely expensive for a free software community. As a result, most such communities are still vulnerable to patent claims.

And there lies the inherent weakness of the free software movement. Born in the hostile legal environment of copyright and trademark laws, it is still trying to defend the right to share knowledge. It can be argued that free software advocates are playing in a rigged game where laws can be changed by intense corporate lobbying and even when they don't, they can rarely protect those who cannot afford to fight in court.

Despite the shortcomings, using open source licensing and practices does offer a protection to some extent. OIN's patent portfolio can be used as a defense mechanism against patent injunctions through its cross-licensing network. It is less effective against patent trolls, as they count on the communities not having enough time or money to fight them. The network numbers more than 600 companies worldwide.

Additionally, modern open source licenses, including GNU GPL v3, incorporate some form of reciprocal patent agreement. And since many of the contributors to open source projects are patent-holding companies, this means that free software communities get automatically protected. When you contribute to the project, your ideas share the protection provided by the license.

Furthermore, the open access type of development that is used by open source communities, with mailing lists, forums, discussion and code out in the open, can act as a defensive publication mechanism to claim prior art against third parties trying to patent ideas of the open source communities. For example, the Linux Defenders program allows patent-like documentation of innovations to be added directly to a database used by the US Patent and Trademark Office in its analysis of new applications.

There are several reasons leading to this success. Computers have largely evolved in academia, where knowledge sharing was the de facto standard to further research. The hacker subculture that originally emerged in academia in the 60s, became more widespread as computers started penetrating the consumer market. The rise of the internet, made possible the creation of network structures of a global scale, expanding them beyond university compounds. In addition, while software quickly became a commodity, its immaterial form meant that, like information, it is non-rivalrous. Making a copy does not deprive anyone from their possessions. This realization casts doubts on the morality of imposed legal restrictions on copying and sharing.

There is another important factor: once the model reaches a critical mass of developers or software matureness, not only does it create a very high barrier for a commercial competitor to entry, but it continues to evolve and spread as people find it useful and expand on it to fit their needs. As the work of anyone that makes use of an open source piece of software has to be published and shared under the same license, the product is continuously improved.

In conclusion, the FOSS paradigm has produced several collaborative experiments, using the Internet as a communication platform and developing novel licensing tools built around copyleft. While it is certainly no panacea, further research would help identify the critical factors that lead to success stories. These including a governance system that leads to sustainability and, as Schweik puts it, those pre-conditions that "somehow establish a situation where participants and/or organizations are willing to devote time, energy, and resources to building these commons" (Schweik 2007, 303).

4. Open Source Initiatives in Agricultural Research and Development

Awareness is growing that the FOSS paradigm is not limited to software and that "it can potentially be applied in any domain that requires a team of thinkers to tackle a problem" (Schweik 2007, 302). Its successful applications have inspired a variety of analysts to propose applications of open source principles and practices to plant breeding and the seed sector. The idea has emerged more or less independently from a variety of disciplines, as Kloppenburg notes on the basis of a literature review: plant breeding, molecular biology, so-

ciology and law (Kloppenburg 2014, 1238). The main rationale was that in a legally defined space in which sharing is unimpeded by IPRs, farmers can continue to apply their local knowledge, in equitable cooperation; and public researchers can continue with scientific plant breeding in the face of global challenges. The open source idea was considered promising, both as a defense against IPRs and as a potentially successful commercial model leading to sustainably funded projects.

The extent to which open source models can be applied to agriculture is subject to debate. An open source model in the agricultural sector would be based on the idea that farmers are both users and developers of both plant varieties and the related information, knowledge and technology. New plant varieties and related technology developed using a participatory process could be made available to farmers and plant breeders with a GPL-styled license with the same viral effect: any subsequent modifications must be openly accessible under the GPL terms, on a contractual promise that there would be no downstream restrictions on the rights of others to experiment, innovate, share or exchange the plant genetic resources. An application of the model would entail an inclusive user community of farmers, plant breeders and researchers through which information and technology may be exchange freely via decentralized commons-based peer-production networks (Aoki 2009). Aoki optimistically argues that such a model would lead to increased capacity of users, rather than creating passive consumers of technologically advanced but legally inaccessible crop technology systems. It would also enable farmers to continue developing plant varieties adapted to particular local situations, and thus prevent genetic erosion. In addition to creating a system allowing for open exchange of knowledge and innovation, the motivations for using an open source model in the agricultural context are further linked to addressing global challenges, including food security, conservation of agricultural biodiversity, farmers' livelihoods and rural development.

An exploration of the structural similarities and differences between the software and agricultural sectors would be useful in illuminating the steps and conditions required for the application of open source principles in agriculture. It would also inform the assessment of the two case studies presented below.

Both sectors can be characterized as knowledge-intensive. At the same time, while agriculture-related knowledge is certainly dynamic, adapting to both environmental conditions and technological advances, information technologies are developing at an extremely rapid pace. The new information technologies are constantly redefining knowledge communities (Ostrom and Hess 2007), including the agriculture-related ones. The reach of these technologies however is not universal. It can be argued that it depends on a series of capacity-, funding-, and education-related conditions. Progress in information technologies impacts directly a University agricultural research facility in the Netherlands, while it may never reach a farmers' cooperative in Sri Lanka.

Similarly, the pace of production and the nature of communities involved in knowledge creation are different. Software developers live online and a community of users and contributors test their products instantly (Jefferson 2006). In contrast, experiments in life sciences take much longer and may be costly, while both formal research and development in agriculture and farmers' innovation may take several years before yielding results. Communities involved in agricultural innovation vary greatly: traditional farming communities contribute to the conservation of agricultural biodiversity by insisting on using traditional varieties to fit local conditions; while scientific breeding takes place in national and international agricultural research centers by specialized groups of scientists. Exchange of knowledge is a characteristic of both these agriculture-related communities. In the case of traditional farming communities however, cooperation and knowledge exchange is a much more localized phenomenon, in contrast to scientific breeders who are, in general, closer to technological innovation and more equipped to use it. This brings the scientific breeders' community closer to the software developers. This is also due to developments in bioinformatics, which make possible the understanding and sharing of biological data.

As described throughout this article, a principal common trend in both sectors refers to the impact of IPRs and the degree of corporate dominance. Farmers' varieties and knowledge

are constantly misappropriated and eventually commodified, leading to loss of knowledge and livelihoods and shrinkage of the public domain. The knowledge and work of software developers employed by corporations are similarly exploited, as any potentially useful creation belongs to the corporation. This was indeed the main reason behind the attempts to apply the open source model in agricultural research and development.

4.1. The Open Source Seed Initiative

The idea for the Open Source Seed Initiative (OSSI) emerged from two meetings held in the US in April 2010 and May 2011, which were attended by a small number of public and private plant breeders, farmers, and NGOs' and indigenous groups' representatives. The idea was to encourage and reward the sharing rather than the restriction of germplasm; revitalize public plant breeding; and integrate the skills and capacities of farmer breeders with those of plant scientists. A key tool for achieving these goals was the development of open source licenses, which are modeled on legal arrangements successfully deployed in the software realm, and that preserve the right to use material for breeding and the right of farmers to save and replant seed (Kloppenburg 2014).

The initiative's basic aims included: a germplasm licensing framework with no breeding restrictions on the germplasm released through its auspices other than that derivatives must also be released with the same license; a well-supported public and community plant breeding sector; a plurality of sources from which farmers and breeders can obtain seed; participatory plant breeding through integration of the skills of farmers with those of plant scientists; and respect for the rights and sovereignty of indigenous communities over their seeds and genetic resources (Kloppenburg 2014, 1239).

Arrangements proceeded on the basis of two open source licenses, with the accompanying copyleft requirements: one was "free," with the only restriction that licensees may not restrict the freedom of others to use the seed in whatever way they wish; and the other was "royalty-bearing," allowing collection of royalties on the seed but not restricting usage in any other way. These two licenses aimed to accommodate two tendencies manifest within the Initiative: one supporting completely free access to seed and rejecting any commodification of life forms, coming mainly from farmers from the South; and one interested in some returns or rewards through royalties, coming mainly from breeders in the North, who looked for revenues to maintain their programmes, in view also of the declining level in state support.

This schism between farmers and breeders reflects not only the different needs between two societal sectors, but also the difference between still existing subsistence-based agricultural economies of the South and market-based economies of the North. In an increasingly hostile international legal context dominated by corporate IPRs, it also reflected cultural predispositions against an agricultural initiative born in the North.

While the initiative is still very young, which places it still in the necessary phase of experimentation and makes any assessment premature, some of the challenges are discussed in the (limited) literature; in addition, some general remarks can be made. As Kloppenburg notes, one of the immediate difficulties was a technical legal one. The initiative struggled over repurposing contract law and drafting copyleft licenses that would be maximally defensible in court, resulting in "seven pages in language that none but an attorney can understand" (Kloppenburg 2014, 1240). The need for such license to accompany every package of seed sold or exchanged resulted in inflexibilities, and a failure to virally propagate, negating the most powerful feature of the open source approach.

Notwithstanding the undisputable difficulties of repurposing contract law, Kloppenburg's remark indicates a weakness of the initiative that may be critical in differentiating open source agricultural initiatives from open source software. In the case of software, online collaborating communities *preexisted* when the idea of open software emerged as a defense against IPRs. Agricultural communities certainly exist, but they rarely unite such heterogeneous groups with different immediate needs, such as public and private breeders, farmers and indigenous peoples' representatives. Farmer and indigenous communities in particular are

usually location-specific. In this context, OSSI seemed to be built on a somehow artificial community, created specifically in order to oppose IPRs and share seed.

Communities are certainly a dynamic concept and are often built around specific resources or needs. However, it can be argued that a novel community based on new collaborations requires a longer experimentation stage in order to first build trust among its members and second develop its own cooperative management strategies. Particularly when it seeks to address complex, globally important problems such as biodiversity conservation and food security, linked to long histories of colonial and neo-colonial domination (Aoki 1998), addressing equity- and redistribution-related concerns (Ostrom and Hess 2007), including through building the differentiated capacities of the community members, can be particularly important. Such governance approaches may delay operation and might impact efficiency, they may however be instrumental for the long-term sustainability of the project.

4.2. The Cambia BiOS Framework

Another case study exploring open source tools in the agricultural research setting, albeit in a narrower framework, is the Cambia initiative. Focusing solely on the researcher, and not questioning use of modern biotechnology methods in plant breeding, Cambia is described on its website as "an independent non-profit institute creating new technologies, tools and paradigms to promote change and enable innovation". At its inception, Cambia used patent revenues to create a sustainable funding base, applying at the same time a tiered licensing system, with the fees depending on the ability of each client to pay. To deal with the transaction costs of negotiating licenses, Cambia proceeded with three interdependent activities: the BiOS Framework, which creates licensing tools making use of open source strategies; the Patent Lens, a platform to investigate patent rights and inform practitioners and policymakers; and Cambia's own research, aiming to create and distribute key enabling technologies (Jefferson 2006).

Patent Lens aims to respond to the obscurity and massive complexity of the patent landscape highlighted above. It includes one of the world's most comprehensive full-text searchable databases of patents, cost-free and open to anyone. It is intended as a public platform to enable many actors to investigate and share analysis of relevant IP issues, and to foster community involvement in overseeing and guiding the patent system (Jefferson 2006). In that regard, it is a valuable tool in the defensive protection against both misappropriation of genetic resources and traditional knowledge previously in the public domain, and IP litigation, as well as positive support to innovation.

The BiOS framework is directly inspired by the changes in ICTs brought about by FOSS. The basic characteristic of the BiOS license is that no fee is charged for use of a "basket" of patented technologies covered. In exchange for full commercial rights to the Cambia technologies offered, licensees are required to comply with three copyleft-inspired conditions: they shall share with all BiOS licensees any improvements to the core technologies as defined, for which they seek any IP protection; they agree not to assert over other BiOS licensees their own or third-party rights that may dominate the defined technologies; and they agree to share with the public any and all information about the biosafety of the defined technologies (Jefferson 2006, 30).

Adenle et al highlight the usefulness of the BiOS initiative for agricultural development, noting that it "has been at the forefront of promoting open source for sharing biological innovation" (Adenle et al 2012, 263). For example, scientists at Cornell University in collaboration with the Hawaiian Papaya Growers Cooperative used Cambia open source research tools to fight a papaya virus. According to their view however, the BiOS license is not flexible enough. Adenle et al propose an open source agricultural biotechnology framework, according to which flexible licencing policies are central in projects involving open source applications in agriculture, to allow for maximum freedom of choice for users/innovators. The framework also includes a series of structural conditions to address the circumstances of developing countries, such as provision of training, resources and facilities, and supporting legislation, in addition to collaborative networks. According to this proposal however, open

source applications seem to be placed at the governments' basket of tools for top-down agricultural development, partly stripped from its political connotations and origin in horizontal communities of users.

In any case, depending on the national legal context, regulatory approval would be necessary for any open source biotechnological application subject to a biosafety risk assessment. Open source biotechnology may be addressing obstacles to innovation in an increasingly proprietary field, but takes a neutral position with regard to the impact of innovation and the thesis that scientific progress should benefit humanity as a whole, with emphasis on those most in need. Scientific and technological progress does not mean that benefits are shared fairly, or that they will reach the most vulnerable groups of society; nor does it mean that all technologies are well-suited for all societal contexts. For scientific progress to contribute to the advancement of broader aims, such as human development, the impacts of different paths and choices for progress must be assessed; and scientific progress cannot be conceived independently of the views of the intended beneficiaries, the society at large, who need to be part of the choices made (Tsioumani 2014).

5. Conclusions

While the economic success of the open source model in software development is unquestionable, the debate is still open on its potential to encourage both open and socially valuable innovation, in response to politically charged global challenges such as food security, rural development and conservation of biological diversity.

Jack Kloppenburg, one of the founders of the Open Source Seed Initiative, offered some valuable insights in his assessment of the experience. Apart from highlighting the practical challenges of drafting workable licenses that create a "legally enforceable mandate for sharing" and afford reasonable protection against IP litigation, he also noted the model's differentiated appeal depending on geo-social location. He remarked that at least in the seed context, there is distrust in the South of an initiative that first originates from the North and second depends on formal licenses. Use or not of genetic engineering tools and methods was also a fault line among participants in the initiative (Kloppenburg 2014), which indicates that a wealth of political, ethical and regulatory issues relevant for agricultural production needs to be addressed and resolved in a specific societal context, before related technologies are managed one way or another.

His assessment points to some critical lessons for agriculture-related communities that wish to experiment with open source. First, given the history and complexity of the matter, experimentation and community-building may take significant time and effort, particularly if the members come from different backgrounds. Second, choices related to agricultural research and development are politically and culturally charged. A community may take a different path than another, and this largely depends to their political predispositions and sociocultural context. Opting for an open source model does not automatically make any technology "good." In addition, it should be acknowledged that, for a large part of smallholder farmers, open source tools would seem just like another foreign idea developed by academics from the North. Building trust would not be easy.

Furthermore, it is dubious whether the open source model takes into account the underlying global inequities regarding distribution of assets and possibilities, which is critical for addressing global problems such as food security. Effective use of open systems requires preexisting infrastructures, knowledge and skills (Louafi and Welch 2014; Aoki 2009) and the largely differing circumstances between North and South render some (individuals and collectivities) better able than others to exploit it. Consequently, open source systems do not seem to solve the equity issues often associated with IPRs. As Louafi and Welch note (2014), open systems would need to develop institutions that redistribute the benefits derived from use to a wide range of actors, in order to integrate equity considerations in addressing global challenges.

The philosophical background of the open source movement is based on the belief that humanity, across history, can operate as a "collective brain," meaning that any produced

knowledge does not belong to its creator but to humanity at large. In practice though, by not rejecting the idea of property, including intellectual property, but rather attempting to manage it differently, it creates its own enclosures.

That said, we understand that we do not operate in a historical vacuum, we are not naïve. Discussing absolutely free creation (of anything) within capitalist conditions would be like handing in Native Americans to armed pioneers of the colonial times. The open source movement does integrate a critique against intellectual property; and it is valuable for proposing a "crack" to individual property more generally, by creating for instance highly popular software programmes that are competitive to corporate-owned ones, by proving that "it can be done!" It has been successful in reintroducing in the public debate an "ethos of sharing" (Kloppenburg 2014), in creating networks that are based on values and not on profit, and in creating positive, autonomous spaces to that regard, thus marking a shift from continuous defensive actions.

As free software advocates note, free does not mean gratis but it stands for libre; It stands for "free" as in "free speech" and not as in "free beer" (Free Software Foundation 2000). However, the freedom to share knowledge is in direct conflict with a political and economic system that is increasingly transforming knowledge to a commodity. Failing to acknowledge that, the free software movement has been partly alienated by the rest of the movements for social change. It has either been consumed by open source advocates detached from the demands for more freedom, or it has cornered itself fighting a legal battle instead of a social one. At the end, rather than limiting the debate on open source systems versus IPRs, issues related to production and management of knowledge are to be addressed in a broader context, as part of the larger political debate on knowledge appropriation, access to information and socially acceptable technologies.

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