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The Duality of Peer Production
Infrastructure for the Digital Commons, Free Labor for Free-Riding Firms

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1 Introduction

There never was a "tragedy of the commons": Garrett Hardin's overgrazing farmers were victims of a tragedy of *self-management*, as they failed to collectively regulate, as equals, their common pasture. When Elinor Ostrom was awarded the Nobel Prize in Economics in 2009, the immemorial notion that there are only two types of goods in the world – private and public, coordinated by markets or the state – was finally put to rest. In the most general terms, peer producers are people who create and manage common-pool resources together. It sometimes seems as if "peer production" and "digital commons" can be used interchangeably. Digital commons are non-rivalrous (they can be reproduced at little or no cost) and non-excludable (no-one can prevent others from using them, through property rights for example). So, practically speaking, proprietary objects could be produced by equal "peers," however we argue that peer production has a normative dimension, so that what chiefly characterizes this mode of production is that "the output is orientated towards the further expansion of the commons; while the commons, recursively, is the chief resource in this mode of production" (Söderberg & O'Neil, 2014, p. 2). Though there are many historical antecedents, the term "peer production," as an object of public and scientific interest, is historically situated in the early 2000s.[1] The meanings associated with a term that is deeply connected to the Internet as it was 20 years ago are bound to change. Today, "peer production" describes a vast array of self-organized collaborative ventures and distributed work arrangements, from the collective practice of peers who advocate for an issue through a hashtag on social media or evaluate restaurants and holiday accommodation on dedicated websites, to participation in hacklabs and makerspaces. This introductory chapter to the *Handbook of Peer Production* focuses on peer production's original incarnations, such as free and open source software and Wikipedia, which depended on the open Internet's affordances for distributed communication, production, and organization. Non-Internet mediated forms such as work in shared machine shops or the development of mesh networks are covered extensively in other chapters in this *Handbook*. We will refer to them if necessary, but they are not our prime concern here. In part, this is because the original forms and understandings of peer production are most relevant to a media and communication audience. But we also choose to focus on Internet-based peer production in order to explore the term's genesis: what kind of "production"? And why is it called "peer"?

To answer these questions, this chapter examines a series of productive tensions located in and around peer production. We begin in our second section by interrogating the meaning of infrastructure for peer-to-peer models, and find that some forms of peer infrastructure have thrived, whilst others were effectively banned. We next consider Yochai Benkler's influential theorization of "commons-based peer production," and ask to what extent it embodies Western, first world assumptions. Our fourth section explores at length the relationship of peer production to the dominant economy. It begins by outlining claims about peer production's transformational potential, which are inspired by

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Benkler's model and often imbued with techno-utopian overtones. It then focuses on the organizational and cultural characteristics which enabled co-optation by, and hybridization with firms. We conclude this central section on peer production's political economy by reviewing the literature which suggests that peer production, despite its alleged utopian potential, has been recuperated by capitalism and enabled new forms of labor-exploitation. Our fifth and final section explains the aims of this *Handbook* and summarizes its structure and content.

2 Peer-to-Peer Infrastructure

In the early years of the second millennium, the word "peer" became widely known because of the conjunction of two distinct understandings, one scientific, the other popular. On the scientific side, legal scholar Yochai Benkler (2002) proposed in his journal article "Coase's Penguin, or Linux and the Nature of the Firm" a seminal understanding of free and open source software (FOSS) as a form of "commons-based peer production" whose productive efficiency, based on the ease and speed of incorporating multiple contributions to an object, surpassed that of firms and markets. Meanwhile in the Global North more generally, the notion of "peer-to-peer" generated wide public interest. This derived from the popularity of practices enabled by the non-centrally controlled, or distributed, structure of the early mass Internet, prior to its subsequent enclosure by proprietary social media platforms (see Birkinbine, this volume; Kostakis & Bauwens, this volume). Such practices, whose archetype was the Napster file-sharing service, included torrenting or exchanging files online for free. What was truly original about Napster is that files available for download were not located in a central computer: these files were stored on the user's machines, who made them available to others through Napster's (centrally hosted) software. Each node, wherever it was located in the world, was accessible and contributed to the peer-to-peer system.

This collaborative production and exchange of content, knowledge, and systems involved participants with varying degrees of ownership and control of the (software/hardware) means of production. A system like Napster relied on participants to function, and they in turn could use the service for free, but Napster soon became a for-profit company (Alderman, 2001). Now, in the second millennium's third decade, we face a somewhat different situation. Peer-to-peer practices such as torrenting have been almost completely criminalized out of existence, but the Napster model of using and contributing to an online service for free became widespread in the mid-2000s, with Facebook an emblematic example. In terms of architecture, for many people the Internet is now a content delivery model on closed platforms such as social media or entertainment streaming networks, not a system allowing users to perform effective peer-to-peer networking. To be sure, peer production emerged in the 1990s and 2000s despite the network's physical infrastructure – the fiber-optic submarine links, terrestrial cables, data centers, cloud storage and Internet of things – being privately owned. A similar paradox concerns the principle of net neutrality, the idea that Internet Service Providers (ISPs) and governments should treat all data equally – instead of charging users differentially or limiting access to certain platforms or applications. It is less of a surprise that net neutrality has lasted this long if we understand it as an example of the neoliberal principle of free and undistorted competition (Cohen, 2019).

It now becomes necessary to distinguish an expansive definition of infrastructure as pervasive digital arrangements, from a narrow one that focuses on physical and material settings only. In restrictive terms, when it comes to peer-to-peer physical infrastructure, or "built networks that facilitate the flow of goods, people, or ideas and allow for their exchange over space" (Larkin, 2013), the potential for non-corporate users to autonomously own and control a global network has been neutralized. In contrast, when it comes to a more expansive definition, the situation is reversed. It should be noted that "infrastructure" is not solely limited to material components: "beyond bricks, mortar, pipes or wires, infrastructure also encompasses more abstract entities, such as protocols (human and computer), standards, and memory" (Bowker et al., 2010, p. 97).

Peer produced digital infrastructure, that is to say free and open source software, is ubiquitous online. Let us consider the foundational LAMP open source web application acronym (Linux, Apache, MySQL, Perl/PHP/Python): Google owes its dominance to Linux (used in Android and Chrome

OS); Apache powers 40% of the Internet's web servers; without the MySQL database, there would be no online commerce (Paypal, Amazon), social media (Facebook, Twitter, LinkedIn), or "sharing economy" (Uber, Yelp); Perl/PHP/Python are also highly popular programming languages. As for Wikipedia, it is no longer an unreliable joke, but a legitimate source of correctness in the age of networked disinformation – in fact, it is among the most popular websites in the world (van Dijck, 2013). The narrow definition of peer produced infrastructure – such as torrenting – was effectively banned; the expansive one – such as updating the Linux kernel – permitted, and put to work for the global communication network.

What might still be possible in the future, despite the platformization of the Internet and arbitrary regulatory mechanisms? Furthermore, what kind of resilient infrastructures will foster people's ability to participate in peer production without over-consuming natural resources and contributing to the destruction of the biosphere?

3 The Exclusive Attraction of Commons-Based Peer Production

We consider first what peer producers are building right now. Many continue to focus on autonomous infrastructure in order to oppose the technological giants and offer an alternative to civil society. Examples include distributed physical infrastructure at the local level, in the form of mesh or wireless community networks (such as Guifi[2] in Catalonia, Freifunk[3] in Berlin, and many others; see Shaffer, this volume); peer-to-peer encrypted messaging and forums (such as Briar;[4] see also Velasco Gonzáles & Tkacz, this volume); hackerspaces, hacklabs, and biohacklabs (see Boeva & Troxler, this volume; Meyer, this volume) community telecommunications infrastructure such as Rhizomatica in Mexico, Columbia and Brazil (see interview with Bloom, this volume; Shaffer, this volume); free digital libraries where copyrighted material can be found and uploaded, such as Memory of the World,[5] Library Genesis,[6] and Monoskop;[7] tech collectives that peer produce services geared towards activists such as VPNs, file sharing, server space, and many others. At the hardware level, peer production projects have developed open source machines, tools, and infrastructure which fight against pollution, such as precious plastic,[8] who make available blueprints showing how to build plastic-recycling machines (see also Braybrooke & Smith, this volume).

Many others have embraced the expansive definition of infrastructure by contributing to Wikipedia (see Haider & Sundin, this volume), project Gutenberg (a volunteer-run text digitization project), or by uploading code commits to GitHub (a code sharing, publishing service and social networking site for programmers whose "social coding" has proved wildly popular with the FOSS community). Why has distributed collaboration between volunteers proved so successful? The promise that peer production is always radically decentralized, collaborative, and nonproprietary (Benkler, 2006, p. 60) has not eventuated: the most technologically advanced forms of peer production have hybridized with the market, as detailed in our next section. But Benkler did not just define peer production's infrastructural characteristics: he also addressed the moral benefits of sharing resources and of self-determination. Peer production, as a way of working collaboratively with peers, can only thrive if people treat each other with respect and dignity. The cumulative impact of non-exploitative micro-actions is profound; a normative model, based on autonomy and the sharing of common-pool resources for the good of humanity, emerges (see Borschke, this volume; Nissenbaum & Benkler, this volume). Further, deliberations are meant to be based on "the authority of the better argument." Stephen Levy ([1984] 2010) showed how this was translated into hacker language in his book *Hackers: Heroes of the Computer Revolution* when he defined hacker ethical principles, such as the commitment to the free access of computers and information, the mistrust of centralized authority, and the insistence that hackers be evaluated meritocratically, and not by "bogus" criteria (age, degrees, etc.) but rather by how well they can hack (Levy, [1984] 2010). In a world dominated by dispossession and exploitation, these "do-ocratic" attributes proved attractive. This explains why the expansive definition of peer produced infrastructure has blossomed into 1,000 flowers, including peer learning (see Antoniadis & Pantazis, this volume), cartography (Fish, this volume), and collective action (Milan, this volume). The *Handbook of Peer Production* showcases this great diversity of peer projects. What unites them is

a common practice: collective control over production and creation processes, recursively intertwined with the means and ends of this self-governed practice, the commons.

That being said, we do not intend to suggest that peer production is truly inclusive. Despite Levy's influential principle, "bogus" criteria have historically shut the door to women and people of color, who have in turn advocated for the importance of recognizing that barriers to entry do exist when it comes to learning how to code and to being accepted in white and male-dominated techno-cultures. Further, racist assumptions of deviant behaviors (such as scamming or spamming) have led various institutions to block access to both corporate and non-corporate platforms, including Wikipedia, in several African countries (Burrell, 2012), reducing the possibility for locals to take part in such projects (Burrell argues in her book *Invisible Users* that the racist interaction which Africans experienced online in the mid-2000s led, in part, to practices such as scamming). Being aware of this history helps to understand how peer production has developed, and who has the opportunity to take part without significant barriers. Verrips and Meyer (2001) describe the collective maintenance of technologies such as automobiles by all available means in a country like Ghana: while peer production, as a desire for autonomy, may occur in contexts of commodity affluence and disposable income, the reappropriation of work and technology can also stem from a need for survival, in the South or in disadvantaged sectors of the North. As influential as Benkler's definition of commons-based peer production was, it seems to reflect the assumptions of settler colonial worlds (see Deka, this volume; Toupin, this volume).

When dealing with social participation, it is always sound practice to ask: who can take part? In this case we should reflect on who the peer producers are, or to put it differently: where can they thrive; what are the material requisites? Specifically, we must consider the context and conditions in which peer production occurs in the North and how they might differ from the Global South, particularly outside of elite circles. Examples of these assumptions include a constant flow of electricity, minimal infrastructural breakdown, and easy access to computers (rather than only cell or mobile phones through which the majority of people access the Internet in the South). In the North, obstacles preventing entry into peer production projects do exist – for women and people of color in particular – but in terms of digital infrastructure, Internet access, and access to computers, barriers are usually low, except for Indigenous people on reserves and to some extent in remote rural areas. In the Global South access may be restricted by class to the elite and middle class; in India, by caste. Conflict might also come into play, when a government decides to cut off access to the Internet as occurred in Kashmir, Baluchistan, Ambazonia (the English-speaking part of Cameroon) or in many other regions experiencing contestation around elections. The point here is not to delight in critical self-flagellation (the *Handbook*'s editors and many of its contributors are located in the Global North), but to be aware of the situated quality of the produced knowledge. Technological development is one of the Global North's enduring ideologies, serving to naturalize domination. The industrial revolution occurred not simply after the slave trade, but thanks to it (James, [1938] 1989; Robinson, [1980] 2000).

Technological power is therefore historically intermingled with processes of dispossession. In more recent cases – such as the subject of this *Handbook* – technologically advanced projects could be framed as constituting, in the Global North, micro-enclaves of privilege. Beyond the reproduction of social domination through restricted access to the free time, cultural capital, and social networks necessary to take part in peer production, what role do the digital commons play in the capitalist development process? The relationship of peer production to market forces forms the subject of the next section.

4 The Digital Commons and Capitalist Production

4.1 Post-Capitalist Imaginaries

Peer production's position in the wider political economy is contradictory: De Angelis and Harvie (2014) note the "ambiguity" between commons-within-and-for-capital and commoning-beyond-capital. This is particularly the case when it comes to peer production's historically preeminent exemplar, the production of free and open source software. FOSS now plays a central role in the digital

economy, because innovation through open collaboration is the new standard, and because enrolling the free labor of scores of volunteers reduces production costs. Yet since the slyly subversive General Public License (GPL) or "copyleft" was introduced in 1989, FOSS has been described by analysts and advocates as portending or prefiguring a postcapitalist future (see Birkinbine, this volume; Couture, this volume; Dafermos, this volume; Dulong de Rosnay, this volume; O'Neil & Broca, this volume).

In the 1990s peer production politics extended beyond communication and deliberation in that they were portrayed as distinct from a capitalist mode of production based on exclusive private property rights. FOSS licenses set up a legal environment in which contributors could entrust their intellectual properties to individuals with whom they had no prior personal contact (Lee & Cole, 2003; see also Spaeth & Niederhöfer, this volume). In other words, workers in peer production abrogate their exclusive property rights over the product of their labor. Many authors have connected this relinquishment of control by peer producers to a future-facing socio-technical imaginary, as well as to earlier models of human cooperation which were historically just as prevalent as competitive market models. Notable examples are activists from the Oekonux network and the Foundation for Peer to Peer Alternatives. In the case of Oekonux, peer production was envisaged as the "germ form of a new mode of production beyond capitalism" (Meretz, 2012), signifying that there is a fluid interplay between the emerging new mode of production and organization and the old model of capitalism and hierarchy: since peer production is understood as dialectically co-constituted by its "other" (e.g., developed as a reaction to and as part of capitalism), in many of its iterations, such as free and open source software, it also advances capitalist interests (for an extended discussion see Euler, 2016; see also O'Neil & Broca, this volume). In recent years a wealth of books (Bauwens et al., 2019; Bollier & Helfrich, 2019; Mason, 2015; Srnicek & Williams, 2016) have also argued that peer production and peer-to-peer infrastructure create digital and non-digital commons and thereby the foundation of a postcapitalist economy, beyond the current economic system. For Bollier and Helfrich (2019), cooperation is a natural human impulse which is stymied by society. They present a range of principles meant to help develop sustainable ventures. In their book *Peer-to-Peer: The Commons Manifesto*, Bauwens, Kostakis, and Pazaitis (2019) show how peer-to-peer is essential for building a commons-centric future. Whilst they do not refer to a postcapitalist imaginary, their commons-based future centered around people and nature gestures toward it. What they set to demonstrate is that peer production all at once encompasses social relations, infrastructure, and new modes of production and property ownership, and that these elements create the conditions for a transition to an economy geared towards people and nature (see also Kostakis & Bauwens, this volume; Pazaitis & Drechsler, this volume).

Journalist Paul Mason (2015) is another author who detects (re)generative power in peer production. In *PostCapitalism: A Guide to Our Future*, he defines peer production as the production of "free stuff that drives out commercially produced commodities" (2015, p. 138). Mason cites Wikipedia as an example of a peer produced space where commercial interests cannot operate. In his view, society has to *design* the transition to postcapitalism (2015, p. 140). To engender this transition, he suggests paying everyone a basic income while automating as many tasks as possible and freeing people to contribute to a peer production economy. Along the same lines, we can cite Nick Srnicek and Alex Williams' (2016) book *Imagining Life After Capitalism*. For them, a postcapitalist economy will liberate us from work; it is through the development of technologies that our freedoms are expanded. Another recent book mobilizing similar tropes and arguments is Aaron Bastani's (2018) *Fully Automated Luxury Communism*. Bastani anticipates the end of societies based on waged work: thanks to activist leftist government's use of technology, society will succeed in mastering our planetary crises.

These authors all herald the advent of a postcapitalist society through changes in wage labor. Most also espouse a deep belief in the transformational capacity of peer production as a practice and in the notion that technology, particularly automation, will save humanity. In short, they all adopt utopian socio-technical imaginaries. According to Sheila Jasanoff and Sang-Hyun Kim (2016), technological development, like science fiction, operates in constant interaction with the social context that inspires and supports its production. And indeed, although the abovementioned depictions of peer production are postcapitalist, it could be queried whether economic growth and constant technological innovation are truly the best way to tackle the environmental and social crises, and whether peer production should not be put to work in a more localized and simple manner, oriented towards "degrowth," for

example (for a discussion of related ideas readers are invited to consult the final chapter of this *Handbook*, "Be Your Own Peer! Principles and Policies for the Commons").

Some Black scholars, who do not refer to a peer production framework, also question the techno-utopian assumptions that many of these accounts of postcapitalist futures espouse (Benjamin, 2019; Noble, 2018). For example, in *Race after Technology*, Ruha Benjamin (2019) criticizes naïve assumption of access to computers and the Internet as a solution to inequality. Further, it is doubtful whether elaborations of postcapitalist futures sufficiently take into account commons-based peer production's role in the present-day capitalist economy. This role is itself a subject of debate: does the fact that firms are benefiting from the free labor of volunteer code developers situate FOSS and peer production more generally within the same exploitative historical trend exemplified by the rise of the so-called "sharing economy" (where, under the guise of increased freedom and flexibility, the social rights of individuals are in effect stripped away, since Uber drivers and others are contractors whose working conditions are precarious, rather than employees benefiting from social protections and rights)? This at any rate was the crux of Kreiss et al.'s (2011) virulent critique of peer production, which in their view represents a step backward for workers' rights. We explain why this critique is only partly justified in the remainder of this section, starting with the organizational structure of peer projects. We then examine the process whereby a labor relation predicated on voluntary participation and the self-selection of tasks has become subsumed into the capitalist economy.

4.2 The Organizational Structure of Peer Projects

The intricacies of self-governance have been a prime focus of research into peer production (Arazy et al., 2019; Auray, 2005; Dafermos, 2012; O'Mahony & Ferraro, 2007; O'Neil, 2009, 2014; Pentzold, 2018). For example, Wikipedia has variously been described as "anarchic" (Reagle, 2005), "democratic" (Descy, 2006), "polycentric" (Mindel et al., 2018), and "meritocratic" (Bruns, 2008). It has also been called a "hybrid of different governance systems" (Holloway et al., 2007), a "self-governing institution" (Spek et al., 2006), a form of "collective governance" (Aaltonen & Lanzara, 2015), an "adhocracy" (Konieczny, 2010), and an "ethical-modular organization" (O'Neil, 2015). From a historical perspective, peer production projects can be likened to self-run organizations such as cooperatives and kibbutzim. However, their most clear antecedents are what were previously known as "voluntary associations" and "collectivist organizations." During the 1960s, the rejection of traditional societal institutions as well as of colonialism and imperialism led to the rise of countercultural groups in the Global North, which explicitly rejected what Max Weber called "traditional" and "legal-rational" forms of authority (Weber, 1947). Social-scientific interest in communes and cooperatives accordingly increased. The workings of collectivist organizations were analyzed by Rothschild-Whitt (1979), who defined them as alternative institutions which "self-consciously reject the norms of rational-bureaucracy" (p. 509). Collectivist organizations are groups in which decisions become authoritative to the extent that all members have the right to full and equal participation. There are no established rules of order, formal motions and amendments, or votes, but instead a "consensus process, in which all members participate in the collective formulation of problems and negotiation of decisions" (pp. 511–512).

Following on from the 1960s concern for more inclusive and participatory forms of activism and politics (Kaufman, 1969), the necessity of rules was recognized in collectivist groups in order to avoid what feminist activist Jo Freeman (1972) called the "tyranny of structurelessness": the absence of explicit rules facilitates power being monopolized by informal cliques who manipulate communications (by approving the declarations of their fellows and ignoring or disparaging those of others) and decisions (by deliberating secretly). In line with this concern – how to democratically organize cooperation amongst volunteers – researchers have examined rule-making in self-organized peer projects (Auray, 2005; O'Mahony & Ferraro, 2007; see also Karp et al., this volume; Pentzold, this volume). Authors who examined the emergence and evolution of FOSS communities such as Debian (Coleman, 2012; O'Mahony & Ferraro, 2007; O'Neil, 2014) and FreeBSD (Dafermos, 2012; Jørgensen, 2007) focused on the "succession problem," that is, on the evolution from an informal mode of legitimacy, organized around the figure of the charismatic founder, to a more formalized and democratic mode.

Online collectivist organizations comprise typically bureaucratic mechanisms such as the maintenance of archives of all decisions, and precise rules (O'Neil, 2009), which are nowadays increasingly formalized in Codes of Conduct. In order to introduce a bureaucratic basis of authority into a community form, members must design democratic mechanisms to limit that basis of authority (O'Mahony & Ferraro, 2007). In Debian the power of the project leader is limited in four ways: leaders must defer to the project; they have limited authority over technical matters; members can recall leaders; and the authority of leaders is counterbalanced by that of a Technical Committee (see also interview with Zacchiroli, this volume). Wikipedia editors who demonstrate their willingness to work for the common good can become "administrators," "stewards," or "bureaucrats" and hence exercise varying degrees of control over other participants. They can be replaced by other Wikipedians: meritocracy and the separation of roles and persons are other key characteristics of bureaucratic systems, in contrast to charismatic and traditional leadership (Weber, 1947). The difference with traditional bureaus is that rules are supposed to be generated transparently and democratically (O'Neil, 2009; Haider & Sundin, this volume). Wikipedia is thus both a formal bureaucracy with a structured system of rules and roles and a "deliberative bureaucracy" as decisions are made through "consensus with universal and equal participation, and care is taken over time to create mutual understanding and agreement" (Joyce, Pike, & Butler, 2013).

In sum, protection from abuse in peer production is provided by the community, rather than by state-backed contracts, so recourse procedures may be unstable; nonetheless, Kreiss et al.'s (2011) assessment that peer organizations offer no protection from unjust domination is incorrect. It remains the case that the legal protection of (for example) the GPL applies to the result of labor, not to workers themselves. Peer organizations are not legally responsible for the welfare of participants, so do not offer the same level of support as formal bureaucracies do (O'Neil, 2015).

How do contemporary collectivist organizations fit into the wider political economy? Table 1.1 maps contemporary configurations of work according to their extrinsic or intrinsic logic (vertical axis) and to the degree of control workers are afforded over their labor (horizontal axis).

Organizations where workers sell their labor for wages and where decision-making rests with a restricted leadership are situated in quadrant A. In contrast to employees of capitalist-centralized firms, independent workers such as informal networks of tradespeople in quadrant C have much greater latitude as to whether to work on a particular job. Quadrants B and D comprise communal forms of labor. The community validation and self-fulfillment of domestic labor are lesser than those accrued by participants in voluntary/collectivist associations, but they exist nonetheless. Indeed, Marxist feminist scholar Kylie Jarrett (2016) draws a comparison between the affective or reproductive work of traditional housewives and the unpaid labor performed by contributors to digital platforms. But where workers in quadrant D have control over their production, workers in quadrant B who freely engage in consumption work (or its more interactive variants "prosumption" and "co-creation") must accept that their contributions to product development or networked communication are subject to an external authority's approval or disapproval, with no possibility of redress: this distinction is perhaps not sufficiently drawn out in Jarrett's (2016) otherwise excellent book, which conflates FOSS labor with that of Facebook users for example.

Table 1.1 Organizational governance and logic: a typology.

	Capitalist logic ("alienated" labor)	*Ethical logic* ("communal" labor)
Centralized governance	A private firms, public administration, non-governmental organizations	B consumption work, co-creation, prosumption
Modular governance	C independent workers, freelancers, contractors	D domestic labor, voluntary/collectivist organizations

Source: O'Neil, M. (2015). Labour out of control. The political economy of capitalist and ethical organizations. Organization Studies, 36(12): 1627–1647. © 2015 SAGE Publications.

In contrast, maintainers in ethical free and open source software projects must take pains not to antagonize contributors, who may not only vote with their feet and exit the project, but have the capacity to use all produced resources and therefore reproduce and "fork" the project into a different direction. Actors may move from one quadrant to another: hobbyists can strike it big and grow into large centralized firms (D=>C=>A), as in the case of computer operating systems or search engines developers. Domestic labor can be contracted out (D=>A/C); firms may attempt to glom onto the energy and creativity of consumers (B=>A) or of collectivist organizations (D=>A) to foster innovation and reduce costs.

4.3 How Capitalism Co-opts Peer Production: The Case of Free and Open Source Software

Early critical understandings of Californian Internet culture (Barbrook & Cameron, 1996), of online communities (Terranova, 2000), and of computer hacking (Wark, 2004) took it for granted that capitalist interests would seek to capture autonomous online labor, though these accounts were in the main written when this co-optation was an interesting novelty, rather than a central component of IT firms' business model, as it is today. But how did the integration of communities of peer producers into the "ecosystems" of firms come about?

Boltanski and Chiapello (2005) had presciently argued in their book on the "new spirit of capitalism," originally published in 1999, that capitalism uses critique to rejuvenate itself, by integrating the 1960s countercultural critique of tradition, boredom, and hierarchy. This helped to justify the freeing of capital, the deployment of anti-welfarist ideology, the weakening of the state and the erosion of organized labor by emphasizing personal liberation rather than social emancipation, which alleviates exploitation. To these insights Fisher (2010) added the legitimizing function of a technological discourse in which hackers are a central productive force. Similarly for Barron (2013), FOSS exemplifies a particularly pure form of the "new spirit of capitalism": a post-Fordist regime of accumulation, arranged around lean firms working as networks with a multitude of participants, organizing work in the form of teams or projects, intent on customer satisfaction, and a general mobilization of workers thanks to their leaders' vision.

In an article detailing how hacker practices and innovations are adopted, adapted, and repurposed by corporate and political actors, Delfanti and Söderberg (2018) reprise the notion that assimilated critiques serve to legitimize capitalism and suggest that hacking itself is being hacked, as "the very idea that tinkering offers a way to subvert the agendas of the powers-that-be has become a foundational myth of contemporary capitalism" (p. 461). Beyond repurposing, technical innovations such as modularized production and distributed mesh networks and retrieval systems are now "integrated in the material infrastructure of capitalism" (p. 476), and coupled with distrust for incumbent actors, aka "disruption."

Christopher Kelty's (2008) influential definition of FOSS projects as "recursive" is key to understanding how what was once perceived as a force resisting privatization has been integrated into dominant circuits of capital. Hackers have extremely divergent politics, but they all agree that proprietary software and intellectual property rights, as well as surveillance and censorship, should be rejected. This stems from the fact that such an opposition constitutes the techno-legal preconditions for the hacker public to exist as such: "recursive politics" aim to consolidate and grow the material conditions for the survival of this public. In contrast issues such as feminism and workers' rights are not "recursive" in the sense that hackers "perceive them to be unrelated to what really matters to them the most, computers and Internet freedom" (Delfanti & Söderberg, 2018, p. 463). This was the key for the disruptive potential of FOSS to be tamed: all firms needed to do was to adopt hackers' core demand (providing access to code through "open" licenses) to ensure that participants could continue to help their environments thrive. The ethical logic of self-fulfillment and the focus on technical excellence did the rest, imbuing projects with a propensity to accept any valid contribution (irrespective of whether it originates from a commercial or communal setting) and an aversion to discussing questions of subsistence ("who can afford to take part?"), as such discussions complicate the notion that contributions are solely evaluated on merit.

The integrated firm-project economic model raises the issue of the sustainability of projects. As Nadia Eghbal observed in her *Roads and Bridges* report: "fundamentally, digital infrastructure has a free rider problem" (2016, p. 106). This tension had been noted since the beginning of FOSS development, when firms were described as harvesting the altruism of volunteer developers (Haruvy et al., 2003), resulting in a relationship between altruistic individuals and selfish firms (Bonaccorsi & Rossi, 2004). That firms are benefiting from the free labor of volunteers situate FOSS and peer production more generally within the same exploitative historical trend exemplified by domestic work. This is a move made by Kylie Jarrett (2016, 2019) who argues, in line with past feminist critiques (Dalla Costa & James, 1972), that unpaid domestic labor is crucial for capitalist production and reproduction. The binary between production and reproduction work renders essential forms of labor invisible.

Lund and Zukerfeld (2020) suggest that profit deriving from what they call the "enclosures model" seeks to increase the price of outputs, whilst profit deriving from the "openness model" seeks to decrease as much as possible the price of inputs. Copyright-based production processes exploit productive activities during labor time, whilst "profit from openness is to a greater extent based on the exploitation of productive activities during leisure time" (Lund & Zukerfeld, 2020, p. 23). For these authors, firm adoption of FOSS is part of an emerging "Openness Ideology" representing a shift from a "profit from enclosures" model (based on the rhetoric of individuals, property, and exclusion) to a "profit from openness" model which extols the virtues of communities, inclusion, and freedom: the peer production of software opened the way for the wholesale capture by commercial interests of free labor. This was facilitated by the introduction of algorithms, which enable social media platforms to extract valuable behavioral data from participants' "digital labor," that is to say labor which does not think of itself as labor (Frayssé & O'Neil, 2015). A concrete example of the process whereby a commons is turned into a commodity can be seen through what Schöpf (2015) called the "commodification of the couch": the commons-oriented Couchsurfing hospitality exchange platform, which enabled the conversion of private households into shareable commons, attracted funds from venture capitalists in 2011, and subsequently started gathering and selling data on the activities of its users.

This brings us back to the critique articulated by Kreiss et al. (2011): in the end peer production amounts to little more than ultra-exploitation. Yet the notion that unpaid participants are necessarily always being exploited should be reassessed. Red Hat, whose Fedora project combines waged and volunteer labor, has a business model which is only possible because products are created at a much lower cost than a fully-waged workforce would entail. Does this constitute exploitation? Firms such as Red Hat are not appropriating FOSS code, which is accessible to all. Benjamin J. Birkinbine (2020) advances the notion of "incorporation" over that of "enclosure" which typically refers to the imposition of higher excludability on the common resource. Instead, "corporations have developed unique ways of transforming the products and processes of commons-based peer production into commercial offerings without placing restrictions" (Birkinbine, 2020, p. 24) on the community's access to their collective resources. As pointed out by Sébastien Broca (2013), this is quite different from the situation of proletarians who are dispossessed from the fruits of their labor. Here the exchange seems to be mutually profitable, even if the goods being swapped – economic profits for the firms, self-realization for the developers – are different. It could even be argued that Red Hat creates an environment where developers can play with passion (Lessig, 2008).

Peer production projects originate from within what could be called a hobbyist sphere, characterized by two inter-related traits: in contrast to salaried work, active users – not just CEOs and managers – can assume concrete strategic and operational control over projects; but these projects do not enable participants to make a living from their volunteer work. The exception to this rule is of course FOSS, where developers were either held to be able to convert the cultural capital acquired in communities into economic capital in the form of employment (Lerner & Tirole, 2002), or – with the adoption of FOSS by firms – simply be recruited to produce firm-oriented free and open source software alongside volunteers. The fact that firms are paying the salaries of developers in FOSS projects was originally found to be notable (González-Barahona & Robles, 2013; Mansell & Berdou, 2010; Riehle et al., 2014) whereas the wholesale integration of FOSS into dominant industrial circuits, partly through waged work, is now deemed complete (Eghbal, 2016; O'Neil et al., 2020a, 2020b).

The hybridity of this collective development (some people are paid, some are volunteers) has generated new institutional formations. Studies of organizational dynamics suggest that firms and FOSS projects are organized around different institutional principles (or "logics"): commercial logics for firms, communal logics for projects (O'Neil et al., 2020a). In order for these organizations to cooperate, discursive legitimation and concrete practical arrangements are required. An online survey of Debian project participants and interviews with Debian Developers found that a first phase of legitimation centered around licenses, in effect since the early 2000s, aimed to erase the distinction between work performed in firms and projects. In contrast a second phase of legitimation, centered around waged labor, put forward the notion that developers should be paid for work performed in Debian. Another finding was that firms were increasingly seeking to configure software to collect analytics in the form of statistics about which buttons users are pressing and which product features are being used, thereby potentially violating FOSS privacy principles, and laying the foundation for future conflicts and forks (O'Neil et al., 2020a).

The rise of the integrated firm-project code development ecosystem can be partly attributed to the rise of the GitHub repository, though some projects have always been reluctant to use GitHub because of its proprietary status. This integration is evident in the business practices of IT giants and in the increasing propensity of end-user firms – not just IT firms – to create Open Source Offices (OSPOs) which will act as open source advocates within the firm, and as firm liaisons with the code-producing open source "communities" (O'Neil et al., 2020c).

5 The *Handbook of Peer Production* Aims to be Inclusive and Political

Like any academic *Handbook* worth its salt, this volume seeks to establish the state of the art of research in a given field of activity; to map origins, manifestations, achievements, and contradictions; to gather a group of contributors who are both knowledgeable and passionate. In addition, our approach is purposely inclusive and political.

When we say we wish this *Handbook* to be "inclusive" we mean that the commons-based and oriented peer production approach towards generating and circulating all kinds of information goods, which fundamentally differs from individualistic models, from the competition of all against all, is occurring in an era where myriad forms of organizing and exploiting collective digital labor are in operation. It is hence necessary to pin down core elements of this alternative model of cooperation and governance such as cooperation and trust, transparency in production, collective democratic decision-making, and the like. However, we also believe it makes sense to chart areas where some, though perhaps not all, these tenets have been adopted. So making peer production "inclusive" means casting the net wider and including a comprehensive range of cognate endeavors. In consequence, the *Handbook* traces peer production's resonance in a broad number of fields, from a wide variety of perspectives.

When we say the *Handbook* is "political," we mean that the chapters investigate and discover new possibilities for political action by re-thinking concepts such as crowdsourcing, making, urban commons, and the partner state, or by conceptualizing the contradictions of autonomous production. Albeit in different guises, all chapters share a concern with how peer producing is intertwined with political issues such as hierarchical power, capitalism, gender, and race. By framing peer production as "political," this *Handbook* offers the possibility of critically exploring the assumptions underpinning, and the contradictions animating, commons-based and oriented peer production; and it also attempts to move beyond critique, towards praxis.

The *Handbook of Peer Production* is divided in six parts. Part I is the shortest, being made of this chapter, in which we (editors Mathieu O'Neil, Sophie Toupin, and Christian Pentzold) set the scene. Part II (chapters 2 to 6) outlines the key *Concepts* which help to make sense of peer production: Vasilis Kostakis revisits a famous Michel Bauwens article to define the core elements, or *Grammar of Peer Production* projects and ecosystems. Benjamin J. Birkinbine defines the *Political Economy of Peer Production*, Christian Pentzold outlines the *Social Norms and Rules of Peer Production*, and Michael Stevenson discusses the *Cultures of Peer Production*. We conclude this part with this volume's sole reprint, Yochai Benkler and Helen Nissenbaum's 2006 article on *Commons-Based Peer Production and Virtue*.

Part III (Chapters 7 to 11) defines the necessary *Conditions* for peer production to exist: George Dafermos defines the *Prophets and Advocates of Peer Production* and Margie Borschke explores *Virtue, Efficiency, and the Sharing Economy*. Next, Mélanie Dulong de Rosnay analyzes *Openness and Licensing*, and Sebastian Spaeth and Sven Niederhöfer focus on *User Motivations in Peer Production*. We conclude this part with an analysis of the relationship between project governance and scope, *Governing for Growth in Scope: Cultivating a Dynamic Understanding of How Peer Production Collectives Evolve* by Rebecca Karp, Amisha Miller, and Siobhán O'Mahony.

Part IV (Chapters 12 to 20) presents *Cases* of peer production practice, including *Free and Open Source Software* by Stéphane Couture, *Wikipedia and Wikis* by Jutta Haider and Olof Sundin, *Collective Cartography: Drones, Countermapping, and Technological Power* by Adam Fish, and *Peer Learning* by Panayotis Antoniadis and Alekos Pantazis. Morgan Meyer analyses *Biohacking*, Yana Boeva and Peter Troxler present *Makers*, and Pablo Velasco Gonzáles and Nate Tkacz critically assess *Blockchain, or Peer Production Without Guarantees*. Finally, Gwen Shaffer retraces the history of *Community Wireless Networks* and Nicholas Anastasopoulos of *Commoning the Urban*.

Part V (Chapters 21 to 27) maps out areas where peer production practices and projects enter into *Conflict* with internal and external structures of power. Mathieu O'Neil and Sébastien Broca address *Peer Production and Social Change*, and Stefania Milan *Peer Production and Collective Action*. Sophie Toupin discusses *Feminist Peer Production* and Maitrayee Deka *Postcolonial Peer Production*. Francesca Musiani assesses *Gaps in Peer Design* whilst Kat Braybrooke and Adrian Smith interrogate *Makerspaces and Peer Production: Spaces of Possibility, Tension, Post-Automation, or Liberation?* We conclude this section with Alex Pazaitis and Wolfgang Drechsler's *Peer Production and State Theory: Envisioning a Cooperative Partner State*.

Having perused this list of authors and chapters, we trust our readers will agree with us that the *Handbook of Peer Production* has succeeded in accounting for the diversity of peer production histories, endeavors, theories, and contradictions. But when dealing with this topic, which is centered around do-it-yourself values such as individual empowerment, cooperation amongst equals, and engagement and participation, this is not enough. It would be impossible to write a comprehensive volume about peer production, and not contribute in some way. We must go further, by connecting peer production to a progressive social agenda.

Part VI (Chapters 28 to 30) therefore defines *Conversions*, elements that will advance peer production. In *Making a Case for Peer Production* we present interviews with practitioners Peter Bloom (*Rhizomatica*), Mariam Mecky (*HarassMap*), Ory Okolloh (*Ushahidi*), Abraham Taherivand (*Wikimedia*), and Stefano Zacchiroli (*Debian*). In *What's Next? Peer Production Studies?*, we (editors Mathieu O'Neil, Sophie Toupin, and Christian Pentzold) outline promising avenues for new research into the contribution of peer production to productive efficiency and to social change. We also reflect on whether the *Handbook* fits into a field of "peer production studies," which necessarily involves a brief discussion of the political economy of academic publishing. Our final chapter, *Be Your Own Peer! Principles and Policies for the Commons* situates the participatory and democratic qualities of peer production in the wider context of current political, health, and ecological crises, and outlines strategic principles and policy proposals aiming to increase sustainability and fairness.

Creating the first *Handbook of Peer Production* has been a privilege. We hope it is of use.

Notes

1 The advent of commons-based peer production in the late 1990s is the outcome of overlapping historical, social, economic, and technological factors, including, but not limited to: (a) the *traditional self-management of common-pool resources* identified by Elinor Ostrom. The bulk of Ostrom's work was applicable to finite natural resources (such as fish stocks in a river) administered by a local community. Such rival resources raise issues linked to their long-time preservation; in contrast digital commons raise issues concerning their production and enrichment (Coriat, 2011); (b) the notion that *sharing knowledge freely*, alongside universalism, disinterestedness, organized skepticism, and communism (later changed to communalism) are the foundations of science: "The communism of the scientific ethos," wrote Robert Merton, "is incompatible with the

definition of technology as 'private property' in a capitalistic economy" (1942: 275); (c) the principle of *peer review* which holds that correctness is more likely to emerge if a statement, or an elegant solution to a technical problem (a.k.a. "hack") is submitted to the scrutiny of a community of peers of equal competence; (d) the uniquely contradictory *historical moment during which the Internet was created* (the late 1960s): the Cold War threat of nuclear conflict between the two superpowers led to the US military's request for a distributed network where digital packets could autonomously re-route around destroyed nodes, so intelligence and control were located at the edges, where packets are disassembled and reassembled, not in a central hub as in a traditional phone exchange (Baran, 1964); this was also the height of the counterculture, with its distrust of traditional authorities and emphasis on personal liberation, a belief that would evolve into diverse branches, one of which was the notion that personal computers represented the means to establish free communications and new types of virtual communities (Turner, 2006). Internet technical protocols were established by organizations such as the Internet Engineering Task Force; IETF "hackers" were computer engineers and students influenced by the counterculture, and therefore resistant to hierarchy. The IETF adopted a non-authoritarian methodology to propose improvements to Internet protocols: RFCs (request for comments) were released electronically, so that innovation was not based on the imposition of authority, but on appeals to a community of peers for input (O'Neil, 2009). The founding belief of the IETF was that the legitimate basis for authority was autonomous technical excellence: "We reject kings, presidents and voting. We believe in rough consensus and running code," said Internet pioneer David Clark (Hoffman & Harris, 2009); (e) the UNIX computer system, which Minix and subsequently Linux were modeled on, has a *modular structure*, signifying that as long as common protocols were respected, new components could be added independently; more generally the Internet and the Web are classic examples of "combinatorial innovation" (Varian, 2010); (f) the rise of personal computers as consumer items and attendant *increased proprietary enclosures around software* in the 1980s led MIT computer scientist Richard Stallman to declare that he would "put together a sufficient body of free software so that I will be able to get along without any software that is not free" (Stallman, 1985), and to create the GNU operating system, the General Public License or "copyleft," and the Free Software Foundation. Whilst Stallman's continued advocacy for the right to freely access and modify code in order to improve it has proved an inspiration for many, he sadly demonstrated in 2019 a lamentable insensitivity to sexism (Musil, 2019); (g) finally the emergence of the *mass Internet* in the early 1990s facilitated the rapid global dissemination of computer code (instead of exchanging diskettes by post), leading to the advent of Linux, and in the 2000s of the writeable Internet ("Web 2.0") including wikis, weblogs, and social networking sites.

2 https://guifi.net/
3 https://berlin.freifunk.net/
4 https://briarproject.org/
5 www.memoryoftheworld.org/
6 https://libgen.is/
7 https://monoskop.org/Monoskop
8 https://preciousplastic.com/

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