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Article

Production and governance in hackerspaces: A manifestation of Commons-based peer production in the physical realm?

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Abstract
This article deals with the phenomenon of hackerspaces and sheds light on the relationship of their underlying values, organizational structures and productive processes to those of the online communities of Commons-based peer production projects. While hackerspaces adopt hybrid modes of governance, this article attempts to identify patterns, trends and theory that can frame their production and governance mechanisms. Using a diverse amount of literature and case studies, it is argued that, in many cases, hackerspaces exemplify several aspects of peer production projects' principles and governance mechanisms.

Keywords
commons, community governance, hacker culture, hackerspaces, open source, peer production

The phenomenon of Commons-based peer production (CBPP) has recently been gathering increasing attention from scholars and practitioners. Researchers have been investigating the governance mechanisms of Commons-based online communities, such as those which participate in free/open source software (FOSS) projects or in Wikipedia,

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arguing that hybrid modes of governance, which share certain characteristics, are exercised (see Bauwens, 2005; Bruns, 2008; Dafermos, 2001; Kostakis, 2010; O'Mahony and Ferraro, 2007; O'Neil, 2009). However, few scholarly studies have dealt with what happens when individuals, immersed in the hacker culture, meet in person and start to organize their productive activities in physical places. These communities found or form open organizations with a strong emphasis on technology and experimentation, where participants share knowledge, ideas, tools and equipment in a community-driven physical space. In this article these formal or informal organizations/communities are embraced by the term 'hackerspaces', and the relationship of their organizational structures and productive processes to those of the online communities of CBPP projects is discussed.

Therefore the aims of this article are to tentatively examine if and how CBPP translates into physical-space practices, and in particular the large number of hackerspaces around the world. Thus the question raised is whether hackerspaces do in fact, and to what extent, replicate governance structures and principles we already observe in online CBPP. To this end, first we shed light on the theoretical framework which defines the context within which the concept of hackerspace is emerging. More specifically, we consider the meaning of 'hacking' as a creative, trial-and-error, experimental, productive and problem-solving process. We then provide a bird's-eye-view of the political economy of CBPP, which is premised on the 'hacker ethic'. Next, we refer to the research methodology as well as the empirical setting on which our ensuing discussion is based. Finally, a brief summary of the argument follows, along with some recommendations for future research.

The emergence of hackerspaces

'Hacking' has been a controversial term during recent decades. It can be claimed that there are various types of hackers: the benevolent, white-hat hacker who, in Wark's (2004, 2013) and Levy's (2001) vein, experiments, tinkers, modifies, creates and/or participates in collective productive projects. There is also the grey-hat hacker who tends to hold a morally ambiguous role (Parker, 2005). Then there is the malicious, black-hat hacker who has criminal intentions, causes damage and/or steals information (Kostakis, 2012). Of course, such a broad categorization entails dangers of misinterpretation; arguably, however, it helps to exclude from our discussion hackers who carry out self-evidently criminal acts, such as overcharging citizens' credit cards.

'The pirate takes another's property', Wark (2013: 73) writes, whereas 'the hacker makes something new out of property that belongs to everyone in the first place'. Therefore, in this article 'hacking' is understood as a creative process, immersed in the 'hacker ethic' of problem-solving (Erickson, 2008) as well as of producing innovative artifacts (Söderberg, 2007; Wark, 2004). According to several scholars (Levy, 2001; Himanen, 2001; Dafermos and Söderberg, 2009; Maxigas, 2012; Söderberg, 2007; Thomas, 2002; Wark, 2004, 2013), who have taken a close look at the phenomenon, fundamental aspects of the hacker ethic include freedom, in the sense of autonomy as well as of free access and circulation of information; distrust of authority, that is, opposing the traditional, industrial top-down style of organization; embracing the concept of

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learning by doing and peer-to-peer learning processes as opposed to formal modes of learning; sharing, solidarity and cooperation.

However, the hacker ethic is not a solid set of norms values and practices but a heterogeneous aggregation of codes ranging from the American and Anglo-European liberal tradition to the leftist, anarchist politics critical of economic globalization that creates a wide and diverse map of practices (Coleman and Golub, 2008). It has been argued that these hacker practices are at the epicentre of the struggle for freedom, privacy and access in the realm of information technologies, or to put it in Coleman's and Golub's words:

> Through regular and shared routine practices of their ordinary, technical life … hackers come to collectively embody evaluative moral and aesthetic dispositions in which knowledge is sacred territory; access to and personal control over the means of information creation and circulation is valued as essential; and technical activity is often experienced as the vehicle for self-fashioning and creative self-expression. (2008: 271)

The hacker subculture started in the 1960s and took off in the 1970s from the MIT Artificial Intelligence Laboratory and other research institutes in the US, as well as from the phreaker scene through the magazine *TAP* (*Technological American Party*) (Maxigas, 2012). The hacker ethic is further considered to share some common characteristics with the hippie culture dating back to the 1950s and 1960s and evolving over the decades through different generations (Hogge, 2011; Levy, 2001; Lobo, 2011) and various socio-economic transformations (Benkler, 2006; Bauwens, 2005; Castells, 2000, 2003). Regarding the latter, the implications of this are discussed later; however, it is important to stress that it is in the context of the networked, information-based society that hackers started to form online and offline communities, sharing knowledge, tools and ideas. Arguably there was a need to organize, in a more systematic way, these conversations among hackers in physical spaces, which led to the creation of communities such as the Homebrew Computer Club in the mid 1970s, the Chaos Computer Club in 1981 or the first hackerspaces, as we know them today, in Berlin (C-base) and Cologne (C4) in the mid 1990s. The phenomenon is not entirely unprecedented and the surge of hackerspaces was also pre-dated by the hacklabs in the early 1990s (for a comparative analysis of hacklabs and hackerspaces see Maxigas, 2012).

Nowadays there are many different initiatives and institutions that consider themselves as 'hackerspaces' (Maxigas, 2012). Troxler (2011) and Maxigas (2012) distinguish different kinds of similar workplaces, such as hackerspaces, fablabs, hacklabs, makerspaces and media labs. In the current article, for the sake of clarity, the term 'hackerspaces' refers to the physical, community-led places where individuals, immersed in a hacker ethic, are to be met with on a regular basis engaging with meaningful, creative projects. Schneeweisz (in Lobo, 2011) argues that it is impossible to find two hackerspaces that are alike and that is why, as Moilanen (2012) points out, there is still no agreed, compact definition of hackerspaces.

Since the establishment of C-base and C4, the number of hackerspaces has grown rapidly and, at the time of writing (August 2013), there are about 896 active hackerspaces around the world and 521 soon to be founded or currently being built, according to hackerspaces.org (2013). For comparison purposes, it is interesting to note down that

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at the beginning of 2007 there were worldwide 30–40 active hackerspaces whereas almost 4.5 years later (July 2011) their number had risen to 480, particularly in Europe and USA (Lobo, 2011). It can be argued that the hacker ethic, through hackerspaces' public visibility and permanent contact with society as an open third space (Farr, 2009; Lobo, 2011; Oldenburg, 1997), is achieving wide dissemination in comparison to the early stereotype of hacking as a marginalized subculture.

It can be claimed that hacking, hackerspaces and the hacker ethic in general are of great interest, especially if seen through the lenses of the political economy of CBPP, in which individuals, immersed in the hacker ethic, have been playing a prominent role.

The emergence of CBPP

Plenty of attention has been gathering around the information production models enabled by the modern information and communication technologies (ICT) and brought to the forefront by collaborative projects such as the FOSS movement or the free encyclopaedia Wikipedia. On the other hand, authors such as Webster (2002a, 2002b) have argued against the idea of an (egalitarian) 'information society'. They emphasize the continuities of the current age with former capitalist-oriented social and economic arrangements (Schiller, 1981, 1984, 1996; Webster 2002a, 2002b). Kumar (1995:154) maintains that the information explosion 'has not produced a radical shift in the way industrial societies are organized' and concludes that 'the imperatives of profit, power and control seem as predominant now as they have ever been in the history of capitalist industrialism'. The widespread adoption of ICT cannot automatically produce a better world for humanity as, following Winner (1986), some technologies need the appropriate social environments to be structured in a certain way. The rise of the information society does not necessarily transcend capitalism: class relations still dominate society today, though with an apparent shift of productive forces from physical labour to cognitive labour (Fuchs, 2012). Thus changes have come to pass in the class structure with the coming of ICT, along with the first signs of an alternative society (Fuchs, 2012).

Because there have been several cases of successful networked-based collaborative projects, some see the emergence of new 'technological-economic feasibility spaces' as setting a new agenda for social practice (Benkler, 2006: 31). These feasibility spaces – we will argue that hackerspaces can be considered as such also – include different social and economic arrangements, in contrast to the claim made by Kumar and Webster, where profit, power, and control do not seem as predominant as they have been in the history of modern capitalism. In these technological-economic feasibility spaces a new social productive model, that is, CBPP, is emerging that is different from the industrial one. CBPP, exemplified by various software (GNU, the Linux kernel, KDE) and content (Wikipedia) projects, makes information sharing more important than the value of proprietary strategies and allows for large-scale information production efforts (Benkler, 2006). In this context, CBPP could be considered an early seed-form stage of a new mode of information production enabled through internet-based coordination, where decisions arise from the free engagement and cooperation of the people, who coalesce to create common value without recourse to monetary compensation as key motivating factor (Bauwens, 2005; Kostakis, 2013; Orsi, 2009).

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Following Bauwens (2005, 2009), CBPP is based on processes which stand in contrast to those of the market-based business firm. More specifically, CBPP is opposed to industrial firms' hierarchical control and authority, but rather is based on communal validation and negotiated coordination as quality control is community-driven and conflicts are solved through an ongoing mediated dialogue. Further, CBPP is generally unrelated to the for-profit orientation of market-driven projects, as CBPP projects have a for-benefit orientation, creating use value for their communities. This does not mean that in CBPP projects, the profit motive is absent, but rather, that incentives such as learning, communication and experience come to the fore. According to Hess's (2005) 'private-sector symbiosis' hypothesis, the emphasis on technology and product innovation can lead 'to the articulation of social movements' goals with those of inventors, entrepreneurs, and industrial reformers. Therefore, 'a cooperative relationship emerges between advocacy organizations that support the alternative technologies/products and private sector firms that develop and market alternative technologies' (Hess, 2005: 516). The case of Linux and IBM affirms Hess's argument. Moreover, instead of the division of labour, in CBPP a distribution of modular tasks takes place, with anyone able to contribute to any module while the threshold for participation is as low as possible. And, finally, it is opposed to the rivalry (scarcity of goods) through which market profit is generated, as sharing the created goods does not diminish the value of the good, but actually enhances it (Bauwens, 2005; Benkler, 2006).

Hence, it becomes obvious that what sets CBPP apart from the industrial mode of production is its mode of governance (meritocracy with consensus-oriented governance mechanisms) and property (communal shareholding). In short, according to the literature (see Bauwens, 2005; Benkler, 2006; Bruns, 2008; Kostakis, 2012) some key aspects of CBPP consist of sharing, abundance of resources, intrinsic positive motivation, openness, collaboration, bottom-up innovation, community accountability, autonomy, communal validation, distribution of tasks, and common ownership of the results. These aspects arguably create an alternative political economy where economic efficiency, profit and competitiveness cease to be the sole guiding stars (Moore and Karatzogianni, 2009) and civil society has a more fundamental role, bringing the notion of mutual cooperation back into the very heart of economy (Orsi, 2009).

Many scholars have highlighted the original characteristics of CBPP and the Commons, considering them either as immanent (Benkler, 2006, 2011; Tapscott and Williams, 2006; von Hippel, 2005), transcendent (Hardt and Negri, 2011; Merten and Meretz, 2009; Siefkes, 2007; Rigi, 2012) or even, following an integrative approach, both immanent and transcendent (Bauwens 2005, 2009) in relation to the capitalist system. Bauwens (2005, 2009) and Kostakis (2013) maintain that CBPP simultaneously creates a new form of capitalism while pointing out how that new form can be overcome. As a hyperproductive mode, CBPP forces the for-profit entities to adapt to its characteristics, 'thereby further integrating it into the existing political economy, but not without the transformative effects of its market transcending aspects' (Bauwens 2009: 121). The take of this article concerning the potential of CBPP is in line with Bauwens' idea that this passionate mode of production (Moore and Karatzogianni, 2009) has features that 'decommodify both labor and immaterial value and institute a field of action based on peer-to-peer dynamics and a peer-to-peer value system' (Bauwens, 2013: 208). CBPP

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functions within the cycle of accumulation of capital but also within the cycle of the creation and circulation of the Commons (Bauwens, 2013). Therefore, with regard to the criticism (in addition see Keen, 2007; Lanier, 2010) directed against the egalitarian potential of the 'information society', which mistakenly equates proprietary-based initiatives (e.g. Facebook) with Commons-based ones (e.g. FOSS), it can be stated that the ICT 'revolution' exhibits both emancipatory/creative and exploitative/dystopic aspects (Fuchs, 2008; Kostakis, 2009).

Research methodology and empirical setting

When dealing with a group phenomenon – such as the emergence of hackerspaces – which has not been thoroughly examined, the in-depth case study may serve as an appropriate approach (Dafermos, 2001; Radloff and Helmreich, 1968). The studies of CBPP projects (see Dafermos, 2001; Kostakis, 2010; Mateos-Garcia and Steinmueller, 2008; O'Mahony and Ferraro, 2007; Shah, 2006) demonstrate clearly the penetrating insights that a longitudinal study permits by covering a time-span in which the project has grown considerably, so that the particular modes of production and governance can be examined in a rigorous manner. However, the aforementioned studies investigate the production and governance mechanisms of, mainly, online communities which collaborate and produce in a state of abundance that is a main characteristic of CBPP projects with serious implications for their governance mode (Kostakis, 2010).

Taking into consideration Schneeweisz's claim (in Lobo, 2011) that it is impossible to find two hackerspaces that are alike, this investigation should include more than one case study in the effort to document some of the basic elements and principles upon which production and governance are based in these places. To enhance the validity of the case study approach, it was decided to focus on eight distinct hackerspaces which have various differences in their date of establishment, degree of activity, legal status, projects run, number of members and guests, and city/country. Initially we contacted the members of 15 hackerspaces around the world that fitted the desired diversity. The eight that were willing to cooperate openly were chosen. This article's primary sources of data consist of the observation of hackerspaces' functions in both a physical (i.e. visiting hackerspaces) and virtual manner (through various mailing lists, foras and web sites). Thus, on the one hand we did not get involved in either the actual development process or in any conversation that took place in the various mailing lists and (virtual) discussion foras. On the other hand, however, we visited two of the hackerspaces and observed some of the activities and the projects run there, revealing our identity. Issues such as authorization to explore the particular organization and questions as to whether to reveal one's 'research identity' (Mayo, 1945; Schwartz and Jacobs, 1979) are not irrelevant when one is physically present, and we are aware of the fact that the group behaviour could have changed due to our physical presence. To reduce the possibility for bias we tried to combine both virtual (where our identity is not revealed as access is open and discussions are public) and physical observation.

This article's primary sources of data also consist of 23 semi-structured interviews by voip, email and face-to-face contact in order to establish a possible connection between CBPP and its physical manifestation in such groups of people. We contacted not only

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individuals who play a key role in the examined hackerspaces, and as a consequence were easier to track down from their respective websites, but also individuals who take part in hackerspaces projects either as peripheral members or guests, mainly those that appeared more active in the mailing lists and foras. Further, we use the empirical data provided by the longitudinal statistical survey of Jarkko Moilanen (2012), co-founder of 5w hackerspace at Tampere as well as investigator of hackerspace communities' ethics. Moilanen, through a random sample of 201 participants in 2010 and 250 participants in 2011, tries to document the demographics and the motivations of those who participate in the production process of hackerspaces. His survey's quantitative results are freely accessible via the open platform Statistical Studies of Peer Production (Moilanen, 2012), and have been featured in the press review of France24 (2011) as well as in an infographics format by Owni (Blanc, 2011).

Analysis and results: production and governance in hackerspaces

The discussion is organized around 11 basic characteristics of CBPP, as outlined before, with the aim of detecting their presence and applicability in the examined hackerspaces. In particular, we see what the interviews and observation evidence say about a specific number of clearly delineated characteristics of CBPP, namely, intrinsic positive motivation; openness; collaboration; sharing; common ownership; bottom-up innovation; community accountability; communal validation; autonomy; distribution of tasks; and abundance of resources. It is important to note that our discussion does not try to be exhaustive or all-inclusive but to answer our question in reference to these fundamental characteristics.

Intrinsic positive motivation

Moilanen's (2012) longitudinal survey shows that participants in hackerspaces are mainly motivated by various positive intrinsic incentives. For individuals who took part in the 2010 and 2011 survey (Moilanen, 2012) the most important factors of motivation seem to be: communication and interaction with other hackers in physical space; fun and learning; altruism; and community commitment. Also, in the vein of online CBPP (Benkler, 2006), money remains a peripheral concept only. Comparing 2010 with 2011 data it can be claimed that the attitude towards earning money as well as reputation-building has become slightly less negative. As Moilanen told us,1 the 'physical hackerspace is needed for several reasons, but I think the biggest reason is social. People want to meet others in the flesh.' All these are consistent with every single interview we took from members and guests concerning their motives for involvement in hackerspaces. In addition, all the interviewees, with one exception, replied that they are or have been contributing to online CBPP projects before their involvement in hackerspaces; however the former did not motivate the overriding majority for the latter. 'I would say that my values (which precede both activities) have motivated my involvement in peer production as well as HS [hackerspace]', Kelly Buchanan, treasurer at the San Francisco-based Noisebridge, says, reflecting the general tenor of the answers we received. Moreover, it

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could be claimed that hackerspace is both a social and a political experiment (as was done by M. Altman, Y. Kargiotakis, N. Brik). 'We're here to make the world a better place', Nigel Brik, co-founder of Utrecht-based Randomdata, exclaims, while Yorgos Kargiotakis from Athens-based Hackerspace articulates that: 'we are trying to change a culture of misery which permeates Greek society against openness, sharing and experimentation'.

Further, Johan Söderberg, a researcher of hacker culture and a hackerspace guest, believes that falling costs, which will make desktop manufacturing equipment (such as 3D printing) more accessible, could lead to the replacement of collective spaces with individualized, desktop workshops. This point is partially echoed by Stelios Tsampas from P-Space in Patras, who underlines that not only social interaction and peer learning but also the cost-effectiveness of hackerspaces concerning equipment was a determining factor for his participation. Although we agree with Söderberg's proposal that an explicit political agenda may provide hackerspaces with a raison d'être beyond just making tools available, we would partly disagree with his former allegation. And the reason for this is that arguably hackerspaces come into existence, as a third place (see Oldenburg, 1997), mainly to satisfy the need of people who share the hacker culture to socialize. Following Oldenburg's (1997) concept of 'third places', the spaces where individuals would gather to exchange knowledge, share tools and create common value could be considered as alternative locations to one's house (first place) and work (second place). Their role, according to Oldenburg (1997), is of a great importance for communities' social vitality because it is through third places that people socialize and satisfy some of their higher needs. Thus, the emergence of hackerspaces can be seen as an answer to the loss of the community reference (Lobo, 2011) and an effort to bring into a physical space emerging modes of social production coordinated with the aid of the internet. Hence, even if the costs, especially concerning equipment necessary for physical production, fall considerably, it could be argued that hackerspaces will not cease to exist because what mostly motivates participants is not shared tools but the social process of sharing the tools.

To conclude, it appears that the involvement in hackerspaces could arguably produce social happiness, as it seems to be based on intrinsic positive motivations similar to those of online CBPP projects (Benkler, 2006; Hertel et al., 2003; Lakhani and Wolf, 2005). Thus, according to the aforementioned discussion, hackerspaces and online CBPP communities are very similar in terms of their participants' incentives.

Openness, collaboration, sharing and common ownership

'The barrier to entry [in hackerspace projects] is to hack on stuff or to help out with whatever needs to be done.' Thus, 'that barrier isn't a door; it's a social thing' Jacob Appelbaum, Noisebridge's co-founder, postulates. The openness of hackerspaces to new members as well as to guests is also stressed in all the interviews carried out with members, founders and guests. Anyone is equally free to participate in any project: 'the only requirement is interest', Mitch Altman, Noisebridge's co-founder, states. However, G., a regular visitor at two USA-based hackerspaces, notices that some spaces are 'radically inclusive. To a fault.… I go there less frequently because they seem to allow people who

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are disruptive.' The degree of inclusiveness and openness differs from hackerspace to hackerspace, and being a paying member may offer some additional provisions. For instance, often it can be 24/7 access to space and tools (from traditional tools to 3D printers, laser cutters, sensors and computers); to storage space for running projects; and to consumable things (from CDs to beverages). Moreover, membership allows full participation in all the examined hackerspaces' official decision-making processes.

Further, seven out of the eight hackerspaces studied explicitly refer to 'do-ocracy' as one of the two modes of decision-making. The second relates to 'bigger decisions' (D. Fotel), such as operational ones (K. Buchanan), which are taken through weekly, biweekly or monthly meetings based on either consensus or voting. Of course, opinions are asked and topics are discussed among participants, as was observed in all the mailing lists or chat of the investigated hackerspaces prior to and/or after the arranged meetings. In addition, David Raison, co-founder of Luxemburg-based Syn2cat, mentions that they have been changing from 'where everybody present could vote to decision taking by the council by majority vote, to consensus in a steering group and back and forth'. Regarding Noisebridge, 'the grand majority of decisions made … are unofficial and do not require consensus' (K. Buchanan). In the same fashion most of the examined hackerspaces 'try to be a do-ocracy, meaning that if you do something, you are more right than somebody who just suggests something on the mailing list' (M.) or, to quote Nikos Roussos, co-founder of Athens-based Hackerspace, 'the more active participants will finally take the lead'. Some decide to do something and they simply start doing it inviting more to collaborate: 'those who dedicate more time and energy for the hackerspace are actually those who define the community's fate and not those who just vote' (Y. Kargiotakis). And after all, to quote Dimitris Tzortzis from P-Space, 'it is better to apologize [after having done something] than asking for permission [in order to do something]'. We believe that the tendency (see Kogut and Metiu, 2001; Lee and Cole, 2003; Raymond, 2001) of open source communities to operate in a meritocracy, but without a clear idea of what merit really means (O'Mahony and Ferraro, 2007), applies to hackerspaces as well. Our data suggests that merit is built upon a mix of organizational building and technical contributions, which may differ from case to case.

Further, the ownership of the infrastructure, which may have been acquired by donations (internal or open), fundraising and/or sponsorship, rests with the community in all the hackerspaces under study. People can take advantage of the infrastructure to work on either community or personal projects. Regarding the latter, it would be interesting to mention Raison's opinion, as it reflects more or less the general spirit of hackerspaces (although it is not an essential part of that spirit): 'I'd prefer people to work on common infrastructure projects … than on their own projects, but at least by working on them [i.e. personal project] at the space, they populate the space and I see that as their contribution.' Sometimes, although everyone can use the infrastructure for a personal project, hackerspaces' community collaborative projects may be prioritized (N. Brik). Also it is often appreciated if people who are running their personal projects contribute something to the community, either financially or in another creative way (D. Fotel).

Some hackerspaces have a clearly defined policy of sharing the results of the projects run using Commons-oriented licences whereas some others do not have such an explicit rule or statement, but they seem to favour Commons-oriented licences over proprietary

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ones. As Altman emphasizes, despite the fact that Noisebridge has only one rule (i.e. 'be excellent to each other'), all the projects are Commons-based, as far as he knows. Of course, the mode of ownership depends on the nature of the project, that is, whether it is software or hardware: 'if it is about collaboratively developing software and you seriously disagree with your team fellows, you can easily break up and continue the project on your own.… However, if we speak about, say, a robot, things become much more complicated' (T. Papatheodorou). Buchanan also notices the difference in terms of property that emerges from the nature of personal projects:

> There are plenty of projects which … are actually personal projects. I may bring in a camera that I want to hack and hack it at Noisebridge and then take it home with me. This is a very common use of Noisebridge's resources. However, none of these projects are 'Commons-based projects' really.

It is obvious that Buchanan's argument is right, but it is also true that even personal projects can benefit from collaborative assistance. Therefore it is important to distinguish personal projects from collaborative ones as, especially in terms of property, the licence/regime/status of the final results may seriously differ.

To conclude, openness, collaboration and sharing serve as the bedrock of hackerspaces' functioning more or less in the way that they define online CBPP. However, in terms of property there are arguably two levels: one in terms of infrastructure and another in terms of results produced. In online CBPP, infrastructure mainly consists of a personal computer and an internet connection –it is distributed and 'personal' – but in hackerspaces things can be more complicated as infrastructure is more expensive and, thus, 'communal' and 'centralized'. That's why the majority of the hackerspaces studied provide different degrees of access to infrastructure for members and non-members. In terms of the hackerspace-based projects, all the investigated hackerspaces are in general Commons-oriented either explicitly or implicitly. Thus, online CBPP and hackerspace projects differ as in the former the Commons-orientation is always and explicitly stated whereas in the latter it can be implicit, and there are cases where personal projects, not really Commons-based, may take place.

Cooperative bottom-up innovation

In terms of bottom-up innovation, quoting Moilanen, hackerspaces serve as a chance 'to freely test new goofy ideas that might otherwise be left alone'. 'There are no boundaries to cross,' he adds. In a reminder of the importance of sharing and collaboration as made evident in CBPP, Altman says:

> People enthusiastically share what they know and love. And people enthusiastically learn from others. We all teach and learn and share from one another. This is so incredibly different from industry, where it is important to hide useful information from one another. When we share, we all learn, and it inspires and encourages creativity. When we keep our knowledge secret, we are not helped by others who may want to help. And by keeping our knowledge secret, we discourage people from exploring their creative ways of exploring, and bettering your project.

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Software development, hardware development and the organization of relevant events are the main three activities that take place in hackerspaces (Moilanen, 2012). However, there is a trend towards hacker communities focusing more and more on hardware development and building things (Maxigas, 2012; Moilanen, 2012; and interview with J. Moilanen), which is consistent with the general tenor of our interviews. They tinker and deal with cutting-edge technologies such as robotics, 3D printing, biotechnology and energy production. For instance, Makerbot, one of the best-known 3D printers, was a project initiated in NYC Resistor hackerspace (Pettis, 2011; also interview with M. Altman). One can find dozens of novel projects running worldwide, from building robots to helping in agriculture to developing FOSS for facial recognition, at hackerspaces.org (2013) project section. However, Bryan Bishop, a practitioner and investigator of desktop manufacturing, assumes that 'any transformative projects will involve people who are probably members of hackerspaces, but it won't necessarily involve the directed efforts of any single hackerspace'. Even if Bishop is right, hackerspaces along with the CBPP movement highlight the underestimated power of meaningful human cooperation and sharing that can deliver innovative results (even in a seed form) and improve existing products (Benkler, 2006; Kostakis, 2012). As Altman vividly notes: 'I am a really good engineer. But I am only one person.'

Community accountability, communal validation and autonomy

Trust is definitely a central pillar of hackerspaces' operation. Especially in smaller communities, social control seems to be enough to ensure security. In comparison to CBPP online communities, hackerspaces' face-to-face meetings trigger more trustworthy behaviour since group members like each other more when they come into face-to-face contact than when they communicate electronically (Weisband and Atwater, 1999). Members try to create a web of trust (N. Roussos) so that everybody may feel the 'space as their home' (Y. Kargiotakis). In rare cases this may not work well (P. Tiefenbacher), so communities take some measures, either beforehand or after a theft (which, however, was mentioned in only one interview, therefore it seems it might be an isolated case), such as electronic doors, surveillance cameras (R. Itapuro), alarm systems (D. Raison) and security locks (N. Brik). People say 'we don't want to monitor our members' and, thus, there is 'no means of verifying that members don't steal other than trust' (D. Raison). Further, it would be interesting to mention two clearly defined rules that were articulated in our interviews and apply in many hackerspaces: 'be excellent to each other' (Noisebridge members) and 'rule 0: do not behave in a way that makes us make more rules' (D. Fotel). It becomes obvious that building trust and solidarity among members is crucial for creating a sense of autonomy and freedom that are embedded in the hacker ethic.

The emphasis on autonomy is evident, as well, in the answers given when participants were asked whether they would run a project in the hackerspace on collaboration with a public institution or a firm. Although some are sceptical or have a negative disposition towards cooperating with a business firm, all maintain that accepting or rejecting such a proposal would depend on the project and on the independence that hackerspace members would have in the working and distribution process of the results. 'We would be

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honoured', says David Askirk Fotel from Copenhagen-based Labitat, as long as 'we provide the hacker view on their project' and 'there is an understanding that any result would be shared with the general public'. In addition, Altman emphasizes that if they were asked to collaborate with 'an organization such as DARPA [an agency of the US military that exists to create technology to help the US military], that has goals that are antithetical to many members of Noisebridge, then it will not happen'. Despite the fact that some hackerspaces are more open than others about running for-profit projects – as M. says, 'several start-ups were founded in/around our hackerspaces' – all the interviewees focus on the nature of the project and autonomy in production and distribution. The general feeling from the interviews is that although for-profit projects are not condemned, profit maximization is avoided, given that the results are usually shared with open licences. In other words, profit-making is acceptable in the sense that it favours the survival of the space and its members. This shows the project-based orientation of hackers, and their eagerness to work and learn through production processes based on autonomy, cooperation and sharing or, to put it differently, through a physical manifestation of CBPP practices.

However, as Buchanan claims, hackerspaces are broader in scope and goals than well-known CBPP projects 'which are inherently limited by having a specific goal (such as the development of a product or resource)'. 'Hackerspaces have an open, boundless goal of enabling learning and hacking and providing any unspecified resources necessary for those ends' (K. Buchanan), while online CBPP projects 'must, by necessity, have rules and standards and local nodes of authority … which allow them to accomplish their specific goals' (K. Buchanan). Because of the fact that online, dispersed communities of CBPP projects lack the physical contact and, after all, the specified goal is what creates them in the first place, it could be argued that a more concrete framework is necessary for CBPP to occur in the digital realm. To summarize, we argue that hackerspaces share with online CBPP the characteristics of community accountability, communal validation and autonomy, but in a much less concrete framework.

Distribution of tasks and abundance of resources

The majority of interviewees mention that, apart from a treasurer/financial manager, there is no other clearly defined role or any sort of classification. The treasurer pays the bills, collects the membership fees and in general is responsible for the financial sustainability of hackerspace. The main source of funding comes from membership fees – we should take into consideration that our interviews and Moilanen's data (2012) point to the importance of independence for the community – with donations (money and/or hardware) from individuals or firms ('without strings', as many stress) and governmental sources playing a supportive role. In addition to the treasurer, some, mostly informally, may hold other roles; for example, public relations manager (J. Moilanen), deputy secretary (D. Raison) and heavy machine tools maintainer (P. Tiefenbacher). This division of roles/tasks is often the result of a 'do-ocracy', as explained before, or a meritocracy (for instance regarding the maintenance of specific equipment that demands a certain level of knowledge or skills). When asked who defrosts the fridge participants from Noisebridge and 5W hackerspaces replied that even 'the fridge is hacked', meaning that a robot has

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been created for auto-defrost. In other hackerspaces defrost and in general cleaning are either carried out by a cleaning lady (M.); by participants based on a certain weekly schedule (N. Lamprianidis); or, in most cases, through 'do-ocracy'. However, several comment that some get frustrated when they have to clean up someone else's mess and that occasionally cleanliness is an issue.

Furthermore, there is a variety of boards and several hackerspaces have no boards at all. This depends on their legal status; for instance, in the USA, some hackerspaces are non-profit 501c3 (J. Appelbaum) or even limited liability companies (B. Bishop). During meetings, as mentioned before, participants discuss operational issues as well as proposals for projects. However, many projects may begin without prior discussion, as a result of 'do-ocracy'. Tsampas submits that 'although we try not to adopt any system of ranking, sometimes it is inevitable because some persons invest more time and energy on hackerspace's processes; therefore their opinion informally may have greater impact'. In a similar vein, Riku Itapuro from 5w at Tampere remarks that they 'value (still) each member despite their input to the hackerspace', but soon they 'will probably go through many common collective's arguments about who is classified to do what and by what standards'.

Appelbaum suggests the concept of 'pseudo leadership' commenting that 'we need no sacred cows; we should all rotate, certainly when it comes to positions of authority'. Pseudo leadership (Ohlig and Weiler, 2007) brings to mind the concept of benevolent dictatorship, where the community tries to keep hierarchy to a minimum, but sometimes leadership is temporarily used when it is really needed. Benevolent dictatorships are common in CBPP (Malcolm, 2008; Raymond, 2001). This concept actually highlights the tensions between hierarchy and equality as well as authority and autonomy in CBPP (Kostakis, 2012 and interview with G. Dafermos). Similarly O'Neil's (2009) three forms of authority (i.e. hacker-charisma, index-charisma and sovereign authority) identified in online tribes seem to apply here also. A mixture of talent and skill, time and effort spent, and rules imposed by the limitations of the material world constitute the wide spectrum of task distribution in hackerspaces. For instance, benevolent dictatorships can be found in the Linux project, where Linus Torvalds is the benevolent dictator (Malcolm, 2008), or in Wikipedia, where Jimmy Wales holds that role. Bruns defines benevolent dictators 'as one of several heterarchical leaders of the community, who have risen to their positions through consistent constructive contribution and stand and fall with the quality of their further performance' (interview in Kostakis, 2010). Kargiotakis, echoes Bruns, when arguing that the person who holds such a role is not an oppressor, but the person who sets the ethos and the guidelines of a certain project: 'People accept this development model because they know very well that nobody is made for everything, and some may perform better in certain tasks dependent on each project.'

Last but not least, it was understood that hackerspaces, unlike typical CBPP projects, do not operate in states of abundance since resources are scarce (from the rented place and cleaning stuff to the shared infrastructure and electricity bills). That is why a shared basis of authority, necessary for the collective groups to survive (O'Mahony and Ferraro, 2007), tends to prevail concerning the organization and execution of operational duties. Scarcity, as we saw, leads to a less distributive infrastructure, which has to be funded and maintained and, thus, arguably, stricter decision-making and control mechanisms have to

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be applied occasionally. Therefore, in comparison to online CBPP, apart from the more generic framework in which hackerspaces operate, scarcity of resources is another key difference that influences the governance and production mode of hackerspaces. However, for now and at least with regard to the hackerspaces studied, it seems that an imperfect mix of leadership, informal coordination mechanisms, implicit and explicit norms, along with some formal governance structures informed by the experience of CBPP are effective in managing scarcity and allocating duties and tasks. Taking into consideration the relatively small number of members (from dozens to a few hundreds) of the examined hackerspaces, forms of representative democracy have not (as yet) prevailed. Concerning CBPP, O'Neil (2009) notes that especially in large-scale projects, open participation with an increasing number of participants makes the governance of the project much more complex. It can be argued that the same may happen in large hackerspaces, which additionally have to manage scarce resources on the one hand, but on the other entail the physical contact which offers considerable compensations.

Conclusions

The aim of this article was to tentatively see whether, and to what extent, hackerspaces replicate governance structures and principles observed in online CBPP. Our answer is that hackerspaces, at least those examined here, could be considered a manifestation of online CBPP in the physical realm but not a direct or a precise transfer due to the scarcity and the subsequent allocation problems of the material world. Although a single hackerspace's projects can be very different from another's and much more different than the CBPP ones, we came to understand that most of the CBPP characteristics examined also permeate the hackerspace phenomenon. Of course, it should be highlighted that CBPP projects differ from the projects run in hackerspaces, in the sense that the former, most of the time (e.g. the Linux project), include thousands of specialized participants who operate in a relatively defined, concrete framework. Moreover, it is obvious that in both CBPP and hackerspaces, issues of independence and autonomy arise, as shown, when it comes to monetary support from an outsider. Even if the ability of the hackerspace community to develop the norms required for CBPP models is arguably put under more stress, we noticed that there are many instances that seem to embrace several CBPP aspects through adopting hybrid modes of governance. These modes, at least for the cases discussed, share certain elements which exemplify CBPP governance mechanisms and characteristics, which are, after all, historically and essentially indistinguishable from the hacker ethic. Thus it can be stated that hackerspaces' various hybrid modes of governance are actually an unfinished artifact that follows the constant reform of social norms within the community, as happens in CBPP (Kostakis, 2010).

Because of the perpetual transformation of hackerspaces and their diverse organizational structures, it seems wise to approach them on a case-by-case basis if we aim for a more detailed account of governance. What we tried to do here is to provide a bird's-eye-view of the trends and norms of eight distinct hackerspaces which are not unrelated to those of CBPP communities. They share the same roots and can be considered as interrelated strands of an alternative mode of development and production, that is, social production. Of course we should be aware of the fact that every hackerspace is unique.

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After all, as Altman (2011) says in a Noisebridge introductory video, 'it's not easy to say what a hackerspace is exactly. You know it when you are in one, but they are all unique because people are so unique.'

It is interesting to note that understanding community forms of organizing can increase 'the range of tools or solutions that society can bring to social problems' (O'Mahony and Ferraro, 2007: 1079). Hence, future research could focus on the role of hackerspaces and their impact on learning, social innovation and urbanism, that is, how hackerspaces, as third places (see Oldenburg, 1997), could influence the design and development of the urban web and potentially offer opportunities for meaningful social interactions among citizens.

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Notes

1. All quotations that have no dates are from interviews; for details of participants and interviews, see the Appendix.

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Appendix

Table 1 lists the names and roles of the interviewees, as well as the methods used for the interviews and dates when they took place.

Table 1. People interviewed for this article.

Name	Role	Method	Period/date
Altman, M.	Co-founder of Noisebridge (San Francisco)	Email	May 2012
Appelbaum, J.	Co-founder of Noisebridge	Email	May 2012
Balaskas, E.	Co-founder of Hackerspace.gr (Athens)	Face-to-face contact	23 February 2012
Bishop, B.	Investigator of desktop manufacturing and hackerspace guest	Email	April 2012
Brik, N.	Co-founder and secretary of Randomdata (Utrecht)	Email	April 2012
Buchanan, K.	Treasurer of Noisebridge	Email	May 2012
Dafermos, G.	Investigator of FOSS projects governance and hackerspace guest	Email and face-to-face contact	May 2012, 20 April 2013
Fotel, D.	Member and ex-chair of Labitat (Copenhagen)	Email	May 2012
G. (anonymity)	Guest of two USA-based hackerspaces	Email	April 2012
Georgitzikis, V.	Member of P-Space (Patras)	Email and face-to-face contact	May 2012, 12 February 2013
Itapuro, R.	Co-founder and treasurer of Hackerspace 5w (Tampere)	Email	May 2012
Kargiotakis, Y.	Member of Hackerspace.gr	Email	April 2012
Lamprianidis, N.	Member of P-Space	Email	May 2012
Lehnardt, J.	Guest of C-Base and member of Co-Up (Berlin)	Email	April 2012
M. (anonymity)	Member of one hackerspace	Email	April 2012
Moilanen, J.	Co-founder of 5w and investigator of hackerspaces communities' ethics	Email	May 2012
Papatheodorou, T.	Member of Hackerspace.gr	Voip	1 May 2012
Raison, D.	Co-founder and deputy secretary of Syn2cat hackerspace (Luxembourg)	Email	May 2012
Roussos, N.	Co-founder of Hackerspace.gr	Face-to-face contact and voip	23 February, 14 April, 25 November 2012, 15 May 2013
Söderberg, J.	Investigator of hackers' ethics	Email	May 2012
Tiefenbacher, P.	Treasurer of Metalab (Vienna)	Email	May 2012
Tsampas, S.	Member of P-Space	Email and face-to-face contact	27 March, April 2012
Tzortzis, D.	Member of P-Space	Email and face-to-face contact	April 2012, 13 February 2013

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