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# Off-the-shelf digital tools as a resource to nurture the commons

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## ABSTRACT

Commons and commoning are of increasing interest to the PD community. We argue that off-the-shelf digital commons can be used in the context of PD to support groups in their commoning practices. This approach presents some advantages: it allows focusing resources on participation rather than software development and it fosters sustainability of results when researchers leave. But how do we understand whether an off-the-shelf tool can be considered a commons or not? Where do we find digital commons? How do we select them? In this paper, we will try to answer these questions by proposing theoretical considerations and practical criteria based on the reflexive account of a case study in Europe.

## KEYWORDS

digital commons, off-the-shelf, sustainability, adoption

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## 1 INTRODUCTION

Commons, meaning living social systems through which people manage shared goods [28], have increasingly become part of PD debates [51, 54, 78, 87]. Digital tools relate to commoning practices by either being commonly developed (e.g. Free and Open Source software [7]), supporting the common management of goods (e.g. [21]), or embedding specific organisational properties (e.g. [23]). In this paper, for ease of writing, we refer to digital tools relating to commoning practices as **digital commons**.

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We argue that off-the-shelf digital tools can be used in PD projects to promote commoning practices [84, 85]. Specifically, we suggest that supporting the adoption of off-the-shelf technologies is promising when the development of ad-hoc ICT solutions is not feasible because of limited resources or peculiarities of the design project. Additionally, off-the-shelf tools are likely to be maintained past the expiration of specific research projects, contributing in this way to the sustainability of the results intended as the "long-lasting impacts or durable outcomes through PD" [66, p. 4], a key aspect of PD [39], and an emerging concern for HCI [40].

We have implemented such an approach in a PD project with a group of activists that use artistic interventions to support environmental reflections. We conducted a series of activities to 1) understand participants' interests and values and which digital technologies they use; 2) use this information to select better fitting digital commons; 3) support the adoption of the selected tools. The core idea is to support participants' achievement of their own goals by facilitating the integration of digital commons in their everyday activities both at an individual level and in their collective and collaborative action (more details in [9]). In this paper, we focus on the second phase, the process of finding and selecting digital commons potentially beneficial to the group. In our experience, determining whether a tool can be considered a commons is a task far less trivial than it appears to be. As such, selecting and implementing appropriate digital commons is also highly related to this year's PDC sub-theme: *What is included and excluded from the commons and who gets to decide?*<sup>1</sup>

This paper begins to answer this question in the specific domain of digital commons by proposing both a) a set of theoretical considerations that can help discriminate what can be considered an off-the-shelf digital commons from what cannot, and b) a list of practical criteria to operationalize the selection of tools. The **theoretical considerations** comprise a distinction between commoning *in* and *through* design (discriminating between technologies that embed commoning practices from technologies that facilitate commoning practices) and two additional issues (environmental sustainability and digital monopolies). The **practical criteria** consist of a set of questions that emerged from the main problems we encountered in the process and the situated solutions we elaborated.

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<sup>1</sup>From the PDC website, "Call for Participation", retrieved at <https://pdc2022.org/cfp/>

The contribution is the result of formalising the reflections we had throughout the project when identifying the digital tools to propose and use. Our approach builds upon Schön's concept of reflective practice [75] that has been consistently used in PD to develop knowledge on "what designers artfully do" [80, p. 102]. In particular, we relied on the idea of *Reflection-on-action* [75], which "takes place after the activity and enables the exploration of what happened and why in order to develop questions, ideas and examples about the activities and practices in focus." [80, p. 102]. In particular, the theoretical considerations we offer are based on a mix of reflections on the literature and our empirical case, while the practical criteria are more deeply interwoven with the project in its development. For this reason, we decided to present the theoretical consideration right after the literature review (section 3), while detailing the features of the project only in section 4.1, right before presenting the practical criteria.

The rest of this paper is organised as follows. We first examine the literature on commons, sustainability of PD practice, and use of off-the-shelf technology in PD (section 2). We then present the theoretical considerations we developed (section 3) and how the set of practical criteria can be used to solve issues in finding and selecting off-the-shelf tools (section 4). We conclude by discussing our approach in light of the study, reconnecting it with the literature (sections 5 and 6).

## 2 BACKGROUND

This section presents how the debate on commons and commoning has developed inside the PD community (and to a lesser degree human-computer interaction and design research) and intersects with two other themes relevant to the scope of this paper: sustainability (of the results) and use of off-the-shelf technologies. These three main topics are relevant as we propose that fostering the adoption of off-the-shelf technology can promote commoning and facilitate the sustainability of the results.

### 2.1 What are commons and commoning

Different perspectives on commons and commoning exist. For instance, Elinor Ostrom has focused on the management of "common-pool resources" – resources shared by groups [44, 62]. David Bollier introduced the idea of relational commons [13], and argued that: "Commons are living social systems through which people address their shared problems in self-organized ways." [14, p. 17]. De Angelis [28] supports that commons are made by: 1) a collectively managed resource, the commons; 2) a group managing the resources, the commoners; and 3) the practices of managing something together, the commoning practices.

De Angelis' and Bollier's conceptions are particularly interesting for PD as they make space for *commoning practices*, often used in PD (e.g. [54, 55, 77]), that allows considering simultaneously different aspects of the ongoing conversations on commons. For example, we can see contributions focusing on economic aspects, by questioning the way resources like money are managed [45] or processes of sharing economic resources that entail practices of sustainable solidarity [49]. Other examples point to specific practices that takes place in specific contexts [5, 36] and that often entails engaging in practices of care [3, 17, 50, 76], in which the economic aspect is superseded by concerns for the quality of relations. Finally, the

discussion on sustainability and urban commons has stressed the importance of people as key players more than public authorities or private companies in implementing forms of commoning [23, 26, 30, 42]. To summarise, the tripartite lens of De Angelis, considering commons as made by the resource, the practices of commoning, and the community of commoners, allow us to discuss the PD's engagement with commoning comprehensively.

A systematic search of the PDC proceedings produced 12 papers referring to commons and commoning<sup>2</sup> allowing us to outline the history of the commons at PDC. Marttila and colleagues [54] introduced these themes in 2014; since then, the topic gained relevance: in 2016 there are three publications, and in 2018 and 2020 there are four. Marttila et al. [54] supported the existence of similarities between the PD approach and commons, such as a democratic political agenda and the effort to build upon communities' capabilities for self-determination. Among the eight papers on commons-related case studies, six [21, 47, 51, 85–87] referred to ICT tool supporting commoning practices while two focused on urban commons [63, 78]. Among the papers focusing on **ICT tools**, one paper [47] focuses on the infrastructural level of long-lasting community network building; one [85] initiates a process with a specific group; two [51, 87] provide insights on the institutional constraints to participation and commoning; and three [21, 86, 87] discusses design processes in relation to concrete objectives. The two papers focusing on **onurban commons**, are centred on supporting the evolution of commoning practices in local NGOs [78] and intermediating within local associations and political institutions [63]. According to [15, 63, 65, 83], commons can potentially re-politicizing the PD discourse (e.g. [15, 63, 65, 83]) while, at the same time, it has been pointed out that any type of PD de facto intrinsically fosters commoning practices [85].

In this paper, taking De Angelis tripartite lens, we focus on what is understudied in the PD conversation on commons, that is how to identify which technologies could be considered digital commons, as this is relevant both because "commons-based peer production" [7] is estimated to have produced new wealth in the magnitude of billions of dollars [33] and because the concept of digital commons has also been adopted by many activists, for example, the ones promoting cooperative forms of production (e.g. [72]). Endorsing the argument on commons as potentially re-politicizing PD, one of the most contentious political themes now is probably sustainability, in the following subsection, we will look at how sustainability has been discussed at PDC and how it relates to the contributions presented at PDC focusing on commons. We see this as a first step toward articulating an approach to identify which technologies could be considered digital commons.

### 2.2 Sustainability and the commons

Environmental sustainability is arguably an intrinsic component of commons, as commons emerged as a means to guarantee sustainable management of natural resources [62]. Moreover, global

<sup>2</sup>We performed a systematic literature review within PDC proceedings. We used the following queries in the ACM digital library: Title:(“commoning”) OR Abstract:(“commoning”) OR Keyword:(“commoning”) "filter": Conference Collections: PDC: Participatory Design,ACM Content: DL - Title:(commons) OR Abstract:(commons) OR Keyword:(commons) "filter": Conference Collections: PDC: Participatory Design,ACM Content: DL.

threats such as ozone depletion or climate change, lead to the legal attempts to manage overarching environmental elements (e.g., the atmosphere or the oceans) as “global commons” [73]. Digital commons - a subset of commons where the resources to be managed are created and/or maintained online [32] - arguably inherit a connection with sustainability. Such a connection has been recently investigated, with a particular focus on free software, which is intrinsically a commons [7]. For instance, in a chapter focused on the evolution of Sustainable Interaction Design published in 2018, Roedel, Odom, and Blevis [69] claim that the potential of free software to support environmental sustainability constituted a compelling opportunity for future research. This beneficial impact was recently recognized in a report of the EU commission [1]. Additionally, in a recent discourse on music technology, it was discussed how wiki-projects [56] and open source/hardware [31] can support more environmentally sustainable practices. On the activist side, the Free Software Foundation Europe launched several campaigns leveraging the environmental sustainability of free software, e.g. *Upcycling Android*<sup>3</sup>.

Moving to PD, in 2018, Poderi and Dittrich published a systematic literature review about the use of the term sustainability at PDC from the beginning of the conference to 2016 [66]. From their studies emerged three categories: environmental sustainability, sustainability of the practice, and sustainability of the results. **PD for Sustainability** refers to those works that use PD methods to support projects targeting environmental sustainability. **Sustainability of PD practices** refers to works centred on a pragmatic connotation, presenting or reflecting on methods adopted to enhance participation throughout the whole process. **Sustainability of PD results** refers to the durability of PD project outcomes, with a particular focus on how to ensure it once researchers leave the field.

Both environmental sustainability and sustainability of the results are relevant to the work presented in this paper. Poderi and Dittrich [66] identified 7 papers addressing environmental sustainability, and 11 papers addressing the sustainability of the results. To ground our work in an up to date review, we ran their query script in the last two editions of PDC resulting in 17 papers [2, 12, 15, 20, 25, 37, 38, 41, 43, 64, 66, 68, 71, 74, 81, 92, 93], highlighting an increasing interest toward this topic, in particular toward environmental sustainability.

**Within the papers that discuss commons presented at PDC**, *sustainability of the results* is discussed in 3 papers [47, 78, 87], while other 2 papers [21, 51] have a different focus but also consider it explicitly; *environmental sustainability* is discussed in 1 paper [21] and briefly mentioned in other 5 [15, 47, 63, 78, 87].

The three papers that reflect on the sustainability of the results present different perspectives. Bidwell et al. [47] reporting on a process to build decentralised telecommunications systems highlight that considering local specificities is fundamental to prolonging the lifespan of shared resources. Based on their experience with urban commons, Seravalli and colleagues [78] support that commoning is an ongoing process rather than a stable arrangement. Teli et al. [87] discuss sustainability in terms of financial and management autonomy in relation to the design of a digital platform fostering alternative forms of welfare. The only paper that directly addresses

environmental sustainability [21] focuses on building a sociotechnical system that allows managing renewable energies produced locally as commons. While a limited selection, sustainability of results can be considered one of the primary outcomes that must be ensured when doing Participatory Design [39]. Likewise, the broader HCI community has lately begun adopting this perspective as well - for instance, Hansen et al. [40] conducted a workshop at the Designing Interactive Systems conference focusing on how to make civic initiatives last.

### 2.3 Off-the-shelf technologies and commons

The attention to off-the-shelf technology is not a novelty in the PD debate. For instance, Dittrich et al. observed how constellations of many different off-the-shelf applications emerged and, therefore, issues of coordination among use, design in use, adaptation, and development became relevant for PD [29].

Recently, Robinson and colleagues [68] presented a case study that demonstrates the potential of off-the-shelf tools by focusing on how participants of a research project on community radios, after a few attempts, refused to adopt an ad-hoc technology and preferred to rely on off-the-shelf technologies. Robinson et al.'s study [68] also engaged a broad community that could themselves decide what technologies to use. From a different perspective, quite some PD literature seem to have investigated off-the-shelf tools in more structured and hierarchic environments such as hospitals [4, 10, 67, 79] or colleges [27]. In the medical environment, the choice of the off-the-shelf tools never seems negotiated. Conversely, in the studies by Davis [27] and Robinson et al. [68] the tools were chosen based on participants' information or preferences.

However, off-the-shelf technology is not widely debated in commons-related literature. The few exceptions include investigations on hacker/maker spaces [88] or on technologies that attract public attention, such as distributed ledgers [24]. Our examination of PDC papers centred on commons revealed only three cases [47, 51, 85] discussing the use of off-the-shelf technologies. In one case, off-the-shelf usage was subordinate to creating a platform supporting leftist think tanks, and the interest in a more consistent adoption was not detailed [85]. Lodato and DiSalvo [51], describe their experience with interactive screens, highlighting how to develop a commoning practice within the limited space imposed by decisions previously operated by the municipality. In particular, the use of interactive screens in public spaces was imposed on the project by the local administration. In these two cases, the chosen off-the-shelf tool did not fall into the category of digital commons. As for the interactive screen, the authors themselves described that case study as a sandbox, given the multiple limitations to participants' decision-making power. The last example is offered by Bidwell [47], who recently investigated the adoption of existing tools for the development of community networks in Latin America. In this case, the investigated tools can be considered commons; however, the study focuses on how the adoption occurred, not on promoting adoption.

Having outlined the background for the recent interest in commons and tied that to our core interests in the sustainability of results as well as off-the-shelf tools, we will now, in the two following sections, outline first our theoretical point of departure before

<sup>3</sup><https://fsfe.org/activities/upcyclingandroid/upcyclingandroid.en.html>

discussing a practical case concerning off-the-shelf digital tools for commoning.

### 3 TOWARD AN OFF-THE-SHELF ADOPTION: THEORETICAL CONSIDERATION

In this section, we will root our choice to use off-the-shelf technologies in the current literature on commons discussed above. Then, we will introduce a set of theoretical considerations that we find meaningful in understanding whether an off-the-shelf technology can be considered a digital commons.

#### 3.1 Off-the-shelf adoption for the sustainability of the results

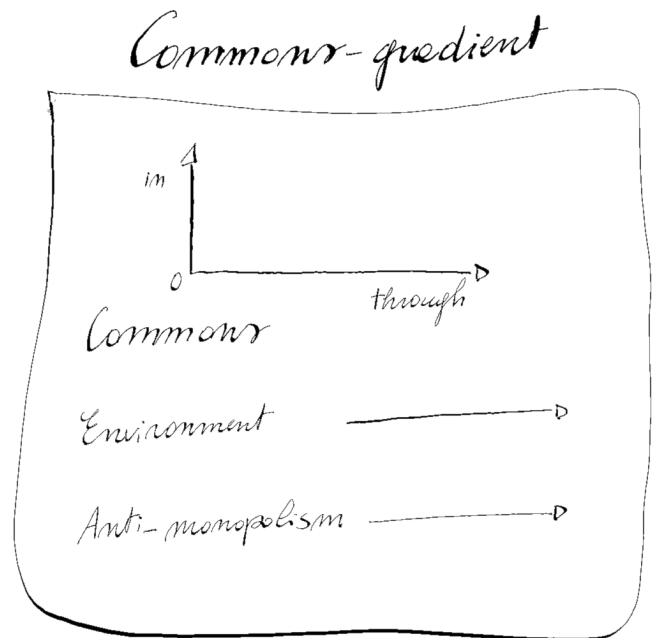
In their systematic review, Poderi and Dittrich [66] identified sustainability of the results as a central concern of PD. Projects supporting commoning practices also deal with issues related to the sustainability of the results, as seen for example in [47, 78, 87]. As discussed in the related work section, most studies on digital commons focus on the design of one single artifact or governance structures. In doing so, one challenge is maintaining benefits for participants over time. Supporting the adoption of off-the-shelf digital tools intrinsically, partially supports the sustainability of the results [66], as it is more likely that such tools will be maintained over time by a wider and already existing community, as opposed to ad-hoc tools developed by researchers. We acknowledge that this advantage solves only part of the issues connected to the sustainability of the results, as commoning practices require constant forms of re-arrangements [78]. However, potentially overcoming maintenance issues is in itself a step forward, (see [22, 91]), and the existence of Free/Libre Open Source Software (FLOSS) and tools embedding forms of collaboration, like platform cooperatives (i.e. CoopCycle<sup>4</sup>) suggests that fostering the adoption of such off-the-shelf technologies can promote commoning.

#### 3.2 Theoretical considerations: the commons-gradient

Our project aimed at proposing better fitting digital commons to a group of activists (see section 4.1). A preliminary phase focused on understanding which off-the-shelf technologies can be considered digital commons. To this end, we looked at commons from two perspectives, firstly we looked at theoretical literature on commons, and secondly, we looked at case studies and activist's work. By combining these two perspectives we propose the commons-gradient (figure 1), as a tool to reflect on commons.

From the literature, we could observe two general tendencies in the discourse on digital commons. The first - which partially intersects the debate on infrastructuring - focuses on commoning practices supported by digital tools (e.g. [60, 70, 85]), while the second focuses on commoning practices behind the creation and management of digital tools (e.g. [7]). However, we could not find in the existing literature any model that formalises this distinction concerning individual digital tools. Therefore, we decided to borrow a classification proposed by Mankoff [53] within the debate on Sustainable Interaction Design. This model turned out to be

<sup>4</sup><https://coopcycle.org/en/>



**Figure 1: The commons-gradient allows to graphically summarise the reflections on one specific digital tool by positioning it on four continuums: commons in/through design, environment, anti-monopolism.**

very efficient in unpacking how digital tools support sustainability. Mankoff suggested two distinct ways digital technology can support environmental sustainability: *in* and *through* design. *Sustainability in design* refers to the "material design of the product" (ibid) embedding sustainable features (e.g. reduced energy consumption). *Sustainability through design* refers to the potential of an artifact to foster environmentally friendly behaviours. We claim that this distinction can be applied to artifacts embedding and supporting commoning practices.

**Digital commoning in design** occurs when technology is open (e.g. released as open-source or with creative commons licences [34]). It also occurs when the technology embeds commoning practices such as in the case of platform cooperativism [72] or commons-based peer production [7]. In these cases, commoning entails the existence and management of a given tool, but using it does not necessarily imply further commoning practices. Identifying commoning in design with FLOSS is a pretty straightforward operation. For example, when someone is using LibreOffice for personal needs, LibreOffice in itself remains a commons.

**Digital commoning through design** occurs when the piece of technology throughout its usage supports practices that privilege commoning over exploitative models but its internal maintenance does not imply the existence of commoning practices. An example is the supply-led carpooling platform (e.g. [18]), that is designed to specifically and exclusively support a commoning practice (in this

case the practice of sharing a car with other people that travel in the same direction).

We also identified two additional issues that are currently intertwined with the discourse developed by some activists and academics working in the area of digital commons: contrasting digital monopolies and supporting environmental sustainability. These issues can be considered as additional layers determined by the current situation that can be used alongside the distinction between in and through design, but may vary in different socio-economic conditions. However, the current global situation suggests that these specific issues will not become irrelevant any time soon.

**Contrasting digital monopolies.** As outlined in a recent report, just ten companies are responsible for almost a third of the total budget for tech lobbying in Europe, insinuating a threat to democratic processes [58]. The importance of contrasting digital monopolies is broadly widespread in the academic literature (e.g. [72, 82, 90, 94]). As stressed, among others, by Fuchs [35] monopolies are the direct opposite of the ideals of commoning. Additionally, the report "creating a digital commons" [59] stresses the importance of contrasting monopolies and proposes strategies to foster commons as a better alternative model. However, we argue that to contrast monopolies opting for a service outside of the few leading companies arguably tend to have a positive effect. Even when the alternative companies are proprietary and rely on closed software, they still can contribute to the diversity of the software panorama. Indeed, as platforms operate driven by a "natural tendency toward monopolization" [82, p. 59.] that take advantage of network effects (ibid), the simple act of shifting toward a less established alternative is a small anti-monopolistic choice, as it supports the existence of a plurality of players.

Taking this perspective to the extreme, choosing Yahoo instead of Gmail would be a (small) step in the right direction. Although both actors aim at establishing a monopoly, Yahoo is sufficiently less influential and will not likely succeed in a reasonable timespan. Choosing Yahoo over Gmail would support an alternative to the dominant actor. This is a borderline example as Yahoo and Gmail do not differ substantially in the service they offer. However, it contributes to explaining that explicitly including anti-monopolistic issues in the commons-gradient was important to discriminate between off-the-shelf alternatives that score equally both in *in* and *through* design perspective.

**Supporting environmental sustainability.** As presented in section 2.2, the debate on commons and sustainability spans from "global commons" such as the atmosphere and the climate system [73] to local resources managed by communities [62], to the sub-set of digital commons, that are created and/or managed online [32]. These levels are mutually intertwined as the global commons depend on the uncountable choices taken on smaller-scale levels, and as the existence of a smaller-scale level (as well as humanity's existence) depends on the maintenance of the global commons. On the one hand, digital commons oftentimes allow for solutions that are more environmentally sustainable than the average; on the other hand, we argue that it is worthwhile unpacking this

category when evaluating a specific tool. Many FLOSS tools, that are commons, in design are capable of reducing carbon footprint, as they can prolong hardware life, lower power consumption, and facilitate a transparent market that allows for more sustainable products [1]. For instance, GNU/Linux operating systems (OS) (e.g. Ubuntu Linux) can be installed on hardware no longer supported or fast enough for Windows or MacOS, thus prolonging the potential lifespan of computers and reducing their environmental footprint. Based on this example, we argue that other digital tools that contribute to preserving the environment, like Teracube or Fairphone (smartphones designed to be easily repaired to have a longer life), could also be considered as supporting the commons.

In the empirical part of our research, we repeatedly faced the question "can we consider this artifact a commons or not?". We discovered that the answer is oftentimes not a neat Yes/No. The answer is often "it depends" as many available off-the-shelf digital tools are situated somewhere in the middle of a sort of a '**commons-gradient**' (figure 1). For example, a tool could support commoning both in and through design, or support just one form of commoning. Additionally, a tool may not be a commons according to more strict criteria but still positively impacts environmental sustainability or contrasts monopolism (although this last issue requires careful consideration). It also depends on how high we are setting the bar, as well as the specifics of the contexts. Overall, each element we discussed (commoning in and through design, environmental sustainability, and contrasting monopolies) can be expressed as a continuum. The comprehensive account of all these considerations can foster a reflection on tools in relation to situated actions undertaken during a PD project.

In this section, we have presented some theoretical considerations that help guide decisions when employing off-the-shelf tools to nurture the commons. In the next section, we illustrate our approach by discussing the practical criteria that we used in our case study.

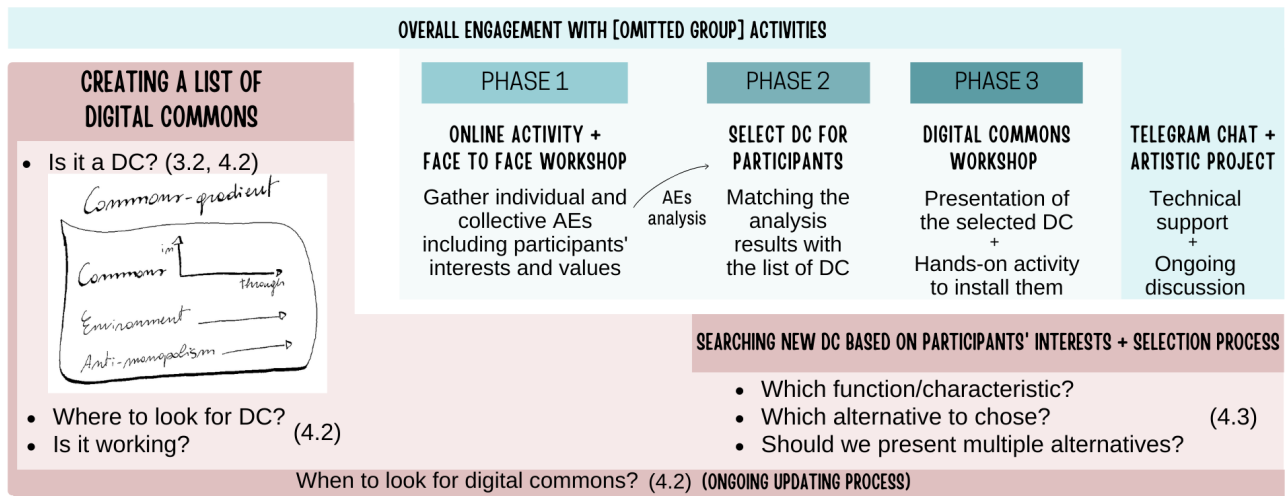
## 4 TOWARD DIGITAL COMMONS ADOPTION IN A PROJECT: PRACTICAL CRITERIA

We faced the issue of understanding whether an artifact is a commons in a project that fosters commoning practice by facilitating the adoption of off-the-shelf digital commons. We reflectively [75] organised the issues that we encountered around a set of specific criteria in the form of questions that can be used to practically select off-the-shelf digital commons.

### 4.1 Context and project overview

Our research was held in Madeira, a 250k inhabitants European island, which is considered an outermost region. We collaborated with Equilibrio, an informal group born in 2019 whose main aim is connecting people interested in developing artistic projects with ecological and social goals. Equilibrio's strategy and actions are grounded on the principle of supporting collaboration rather than competition, mirroring one of the core aspects of commons and commoning [52, 57]. We chose this group because of its tendency to organise horizontally rather than following hierarchical structures. For example, Equilibrio provides its members with occasions to

Timeline



**Figure 2:** This image positions on a timeline the overall project context (in blue) along with the questions we faced while creating a list of digital commons (DC) and while selecting the ones to present to the group (in orange). These questions are connected both to the theoretical considerations and to the practical criteria, thus in the figure we refer to the sections of the paper tackling each specific aspect.

share their knowledge and ideas through workshops and presentations. These moments were meant to allow members to get to know each other and promote further collaboration over shared projects. This type of non-hierarchical organisation is relatively rare in the socio-cultural context where we operate and was crucial to propose a process based on a participatory approach.

Author1 and Author2 became part of the group, participating in its activities from the foundation. This allowed us to build mutual friendship and trust, and a relationship that goes beyond the structured activities of the group (e.g. we received and made invitations to social gatherings and we were included in an informal network of gifts and favours exchange which is typical of friendly relationships in this cultural context). We were part of the initial workshops and presented ourselves as researchers and activists that investigate processes to spread digital commoning. Our project aimed to support participants in adopting digital tools better connected to their interests and values. To this end, we developed a three-phase project; all the phases were discussed with the two founders and leading promoters of the group in advance. A detailed account of this process is out of the scope of this paper and can be found in [9]. In the following paragraphs, we briefly outline the **three phases** to provide some context (blue in figure 2) to the reflections on digital commons that are the core of this paper (orange in figure 2).

**Phase 1.** We organised an online activity followed by a face to face workshop to collect information on participants' Artifact Ecologies (AEs), the complex set of artifacts in use by a person [11]. Moreover, we asked participants to connect the artifacts in use to their interests and values, and to create collective AEs around shared interests and values. We analysed the collective AEs following a procedure similar to the recursive process of Thematic Analysis [16]. We transcribed all the artifacts and the interests and values

of each collective AE; then, we coded and recursively clustered and harmonised themes and sub-themes. Finally, we cross-checked our results with participants' brief AEs descriptions. The analysis revealed a mismatch between the digital artifacts in use and the rest of the AE. Namely, the non-digital artifacts included specific tools for carefully selected activities (e.g. tools for organic agriculture or self-production) coherent with the values expressed (e.g. a general opposition to capitalism and attention to environmental sustainability). On the contrary, digital tools tended to be considerably less numerous and specific (e.g. Facebook and WhatsApp), and did not seem to match participants' values.

**Phase 2.** The next step was drawing on our AE-analysis to select off-the-shelf digital commons that could support participants' interests while adhering to their overall values. To do so, we went back to the list of digital tools that we had previously compiled based on the theoretical elements described in section 3.2 and the practical criteria that we discuss further in 4.2. We searched the list in light of the analysis of participants' AEs; in some cases, a digital commons that fit participants' needs was already listed, in other cases, we had to further research new specific functions, or evaluate competing options (see section 4.3 for further details). For example, we started looking for tools supporting environmental sustainability as nature was a theme encompassing most AEs. Thus, we selected tools that had a positive environmental impact in comparison to similar tools currently in use by participants. At the end of the process, we selected 7 tools that were likely to be appreciated by the majority.

**Phase 3.** We then organised a face to face workshop to propose the digital commons we selected. We began by presenting our analysis of the AEs and collecting feedback. For each digital commons we first presented it highlighting the elements of the AE that led

us to pick it; second, we engaged in a discussion on the tools with the participants; third, we invited the participants to download and install the tool, and we provided technical support to the least tech-savvy. Most participants installed nearly all the digital commons we presented.

Given the positive response, we proposed participants join a **Telegram group** we created to continue the discussion and receive additional technical support if needed. Another result of this third phase has been the adoption of four digital commons in the main **collective artistic project** of the group. It is worth noticing that the structured 3-phases process and participating in other people's activities reinforced each other. On the one side, our wider engagement allowed participants' to get to know and trust us. On the other side, the three-step process we proposed operated in two directions: first, it supported participants' reflection on the adequateness of the tools currently in use with their values; second, it allowed participants to see us as "the experts" in the topic. Reaching the status of "trustworthy" persons, "experts" in finding effective digital tools more adequate to the group values have been particularly valuable in supporting the adoption of digital commons in the development of the collective art project (that will be discussed in 4.4). Moreover, before we reached this status, Author2 presented a list of FLOSS that could be used in alternative to commonly used tools and offered technical support. No one contacted him nor installed any tool he proposed.

## 4.2 Finding the tools

Finding off-the-shelf digital commons is not a standard objective of academic research; meaning there is no consolidated research method to perform it. Additionally, as discussed in section 3.2, evaluating if a specific digital artifact is a commons is complex: is not only a matter of searching for them. Below, we formalise the reflections we had during the process to produce a set of questions that structure this section. This approach, while not conventional, follows Light's [48] invitation to experiment with new forms to report on PD work. Organising the practical contribution of the paper as a set of questions allows us to better convey the reflexive work that unfolded during the process and might offer paths to future research with similar aims.

**Is it a commons?** To an extent, this question is central in this paper. As a tool can be a commons from one perspective but not from another, the commons-gradient 3 can help to unpack multiple relevant aspects. Additionally, we always need to consider which tools are already in use: in some cases, even proposing tools that are not "proper commons" can contribute by contrasting closed ecosystems or monopolies.

*Is it a commons in or through design?* In our project, the initial step has been trying to understand if a tool allows for commoning in or through design. While open licences and FLOSS unequivocally identify commoning in design, also proprietary tools can facilitate commoning through design; thus, we chose to include tools that fall in both categories. For example, Blablacar - a supply-led carpooling platform - is not a commons in design but fosters commoning through design. The tool is provided by a for-profit company that

does not release the code. However, the platform is specifically designed to allow people to offer lifts in exchange for companionship and sharing expenses.

*Does it foster environmental sustainability?* As we have argued above, the issue of environmental sustainability can help to discriminate whether a tool can be considered commons. In this perspective, we decided to include HappyCow, which locates vegetarian and vegan restaurants, as choosing plant-based options contributes to reducing carbon footprint.

*Does it offer an alternative to corporate fatcats?* Based on the issue of digital monopolies, we included Telegram in our list, although it cannot be entirely considered a commons in design as its code is not entirely open. We operated this choice once we noticed that most of our participants solely relied on WhatsApp, a Facebook-owned system.

*Is it still a commons?* As the process of identifying tools recursively happened over a long timespan, some tools changed policies decreasing their commons-gradient. One example is the progressive commodification of Couchsurfing. It initially fostered both commoning in design (it relied on donations and volunteer work) and through design (people shared hospitality), but it first changed its legal status, becoming for-profit, it then excluded voluntary work, and finally introduced a paywall. This kind of evolution is not unique to platforms that reach great numerical success.

**When to look for commons?** The search for digital commons took place during a long time span. We started collecting them before phase 1, and we enriched the list to cover specific interests discovered through participants' AEs or the ongoing conversation. Overall, compiling a list of digital commons should be seen as an ongoing process, also because the offer is constantly evolving and the larger the gamut of known tools, the easier to find suitable matches.

**Where to look for commons?** To create a list of digital commons, we implemented the following strategies:

- (1) We created a spreadsheet with the digital commons we already knew and enriched it throughout the whole research process.
- (2) We noted tools serendipitously found during the research time-span and performed a query in a browser to snowball from there.
- (3) We selected tools from the players we identified in research on the collaborative economy [8]. We performed systematic research in an anonymous browser geolocalized in Portugal, using keywords such "sharing economy", "collaborative economy" in English and Portuguese<sup>5</sup>.
- (4) We followed initiatives centred on digital commons (e.g. conferences on platform cooperativism such as La Coop des Communs<sup>6</sup>).

While compiling our list, we discovered several **repositories and maps of digital tools**. None of them was comprehensive enough to satisfy our needs on its own; however, they contained

<sup>5</sup>Platforms under the broad sharing economy umbrella are often not aligned to commoning. Nevertheless, that umbrella is sufficiently broad to include suitable tools.

<sup>6</sup><https://coopdescommuns.org/fr/association/>



name	description
<a href="https://ioo.coop">ioo.coop</a>	map of platform cooperatives
<a href="https://fair.work">fair.work</a>	rates gig-economy platforms working conditions (limited number of Countries + cloudwork)
<a href="https://digitalsocial.eu">digitalsocial.eu</a>	repository of projects using digital technologies to tackle social challenge
<a href="https://digitalsocial.eu/map">digitalsocial.eu map</a>	map of digitalsocial.eu projects
<a href="https://ethical.net">ethical.net</a>	repository of ethical alternatives, ordered by function
<a href="https://alternativeto.net">alternativeto.net</a>	repository allowing to find digital alternatives starting from already known software (open source filter)
<a href="https://knightlab">knightlab</a>	repository of open source storytelling tools
<a href="https://le.alternative">le.alternative</a>	repository of privacy oriented alternatives (only in Italian)
<a href="https://economie.gouv.fr">economie.gouv.fr</a>	repository of platform cooperatives (only in French)
<a href="https://f-droid.org">f-droid.org</a>	repository of free software application for Android

**Table 1: List of maps and repositories that proved useful in finding digital commons**

so many digital tools that we decided to compile a list of sources (see table 1) rather than adding all the digital commons to our list. This list contains free software repositories (e.g. [f-droid](https://f-droid.org)<sup>7</sup>), websites collecting alternatives to monopolistic tools, and focusing, for example, on platform cooperativism (e.g. [ioo.coop](https://ioo.coop)<sup>8</sup>), or privacy and ethical oriented services (e.g. [ethical.net](https://ethical.net)<sup>9</sup>). We relied on these resources to 1) actively search for tools; 2) make additional research and comparisons among tools after collecting participants' interests and values; 3) respond to their specific requests or needs.

**Is it working?** Despite appearing trivial, this issue comprises specific problems we faced, presented here in the form of subquestions.

*Is it still supported?* Choosing tools that are likely to be supported in the long term is essential. For example, while looking for tools allowing for borrowing household items among neighbours, 3 out of the 16 solutions we found were still downloadable but no longer supported.

*Can it be accessed?* As Portugal is a small market, sometimes a specific tool is not downloadable or SMS-confirmation might not work with local phone numbers. One last and very specific issue was tied to being located on an island. After proposing to participants an app for second-hand items exchange, we discovered that Madeira was not covered by the automated shipments, which rendered it tricky to use.

*Does it exist in a known language?* Many apps have been developed targeting a specific geographical area, and despite being technically accessible and fully functioning, they are only available in unknown languages.

*Is it usable?* This last issue is related to the classic HCI problem of usability. In our experience, many interesting tools' interaction design is suboptimal in average contexts of use. For example, we successfully used Framadate (a FLOSS web service for managing polls) with peer researchers; however, when participants' used the mobile version, the lack of a recognisable "scroll" button led people to reply only considering the first visible options.

<sup>7</sup> <https://f-droid.org/>

<sup>8</sup> <https://ioo.coop/>

<sup>9</sup> <https://ethical.net/resources/>

These four questions represent the process leading us to compile a list of around one hundred eligible tools. In the following subsection, we analyse how we selected the tools to propose to our participants.

### 4.3 Selecting the tools

To select the tools, we matched the AEs analysis with our list of digital commons. In some cases, we compared tools offering similar services, and performed additional searches in repositories enlisted in `tab:sources`. In this section, we outline the questions derived from our experience in coupling our participants' interests and values with digital commons.

**Which function/characteristic?** Gathering information on participants' needs and on the artifacts already in use is fundamental to clarifying the desired functions and characteristics of the digital commons. In our project, we achieved this result both through the structured 3-phase process and by becoming active members of *Equilibrio* (see section 4.1).

In phase 2, we decided to prioritise tools that covered the interests of most participants. For instance, a sub-group was interested in music but we did not present any related digital commons as this interest was not predominant. In the case of the collective artistic project, such prioritisation was unnecessary as the group performed its internal self-negotiations. AEs' analysis highlighted a clash between anti-capitalistic values and participants' reliance on monopolistic platforms (e.g. Facebook, Whatsapp or Google Maps). All these tools score poorly in the commons-gradient; therefore, we presented alternatives that scored better both in anti-monopolism and commoning in design, such as apps for chatting (e.g. Telegram and Signal) and maps (e.g. OpenStreetMap with the mobile app *Osmand*).

**Which alternative to choose?** After defining participants' interests and orienting values, multiple relevant tools might have the same functionality. In this case, several factors should be taken into account. For instance, a tool interesting from the perspective of commoning in design might be more complicated to use, and therefore risk alienating participants.

In our case study, the instant messaging apps provide a good example. After noticing a discrepancy between participants' agonism toward capitalism and the chatting apps in use, we identified three possible alternatives: *Conversation*, *Signal*, and *Telegram*. *Conversation* is an open-source (commoning in design) Jabber/XMPP client allowing the use of self-hosted chat services (commoning through design). However, it is necessary to either self-host a chat service on a server or pay to create an account provided by *Conversation*. Paying was not an option and, although *Author2* could create accounts for all the participants in his self-hosted XMPP, this option would not be sustainable over time; in fact, participants would have not been autonomously impairing the sustainability of the results as identified by *Poderi* and *Dietrich* [66] (see also section 2.2.) For these reasons, although *Conversation* is an excellent example of digital commons, we chose not to propose it. None of the two remaining options - *Telegram* and *Signal* - had characteristics that lead to a strong preference for

one over the other. This brought us to the next question we had to face.

**Should we present multiple alternatives to participants?** In case of doubt, presenting multiple choices allows for more open and democratic processes. However, additional decision processes are time-consuming activities and reduce the functions that it is possible to support, so a balance must be strived based on context. In the case of instant messaging clients, both Signal and Telegram were eligible as they were free, easy to use, and offer an alternative to WhatsApp. Signal fits better the category of commons in design as it is funded by a community, while Telegram is funded by a single entity. However, although our participants were not using it, Telegram was locally better known than Signal. Therefore, each participant would immediately find some “active” contacts, making Telegram preferable from the perspective of the sustainability of the results. In this case, we decided to include participants in the decision process; after presenting advantages and disadvantages preference went to Telegram.

#### 4.4 Sustainability of the results

As we are still partially engaged with Equilibrio, a formal evaluation was not possible. However, after 13 months from the end of the structured activities, we can observe encouraging results. During phase 3 we held a workshop presenting several digital commons, including Telegram (see 4.1); 8 people out of 10 did not have Telegram, and 7 decided to download it. After more than a year, all of them are still using it and are part of the Telegram group we set up to support the conversation in an informal and not intensive way; although a couple of members disengaged from the active conversation after a few months, we still receive spontaneous contributions. Furthermore, three additional persons joined this group after its initial creation. This in itself can be considered a positive result in terms of sustainability. Participants used this group both to ask us for new tools for performing specific tasks and to get technical support. Additionally, they used it to interact among themselves (e.g. to compare experiences using Duckduckgo vs Google, or opinions on buying sustainable vs second-hand hardware). Additionally, two participants took the initiative in suggesting digital commons. One promoted several privacy-oriented alternatives. The other, followed our lead and suggested an app to facilitate lending/borrowing items that she found on her own.

Additionally, in a couple of cases participants have spread to a wider audience digital commons suggested. Equilibrio’s organisers adopted two digital commons to support a project with a different group; in this context, they are currently using Mega.nz instead of Wetransfer.com to share audio-visual material and they used Jitsi.org instead of Zoom.us when they needed to organise online calls. More recently, one participant followed up on our recent suggestion of Reforma Agraria<sup>10</sup> a national, bottom-up platform connecting farmers and consumers. He is part of a small purchasing group, which is now planning to use the platform to widen the range of products they distribute.

Promoting off-the-shelf tools contributed to participants’ independence from researchers as they could access resources such as

<sup>10</sup><https://www.reformaagraria.pt/>

tutorials or forums [65]. For example, in our case study, the two founders of the group set up a collaborative map for the collective artistic project using Umap<sup>11</sup>, one of the digital commons we presented. They received no substantial technical help from our side, and they simply relied on the online how-to and forums.

Additionally, as they could not find a brief tutorial in Portuguese, they recorded a video-tutorial to help less tech-savvy members contribute to the map. This tutorial has been uploaded on YouTube and thus made available to everyone interested in Umap. Moreover, before discovering the existence of this digital commons, Equilibrio had allocated most of its funding to pay a software house to build an ad-hoc solution. The possibility of relying on an off-the-shelf tool allowed this group to redirect monetary resources to sustain their project further, in particular by paying local artists for content creation.

## 5 DISCUSSION

In this paper, we proposed that fostering the adoption of off-the-shelf digital commons can be effective both to promote the commons and from the perspective of sustaining the results. To practically implement such an approach, finding and then selecting the tools is crucial. Moreover, understanding whether a digital tool can be considered a commons is not always immediate. Therefore, we proposed some theoretical considerations and practical strategies that can help discriminate whether a tool is a commons and facilitate comparisons. We will now discuss these points.

### 5.1 Off the shelf and sustainability of the results

Off-the-shelf technologies can be beneficial for two reasons. On the one hand, they reduce the effort researchers should put into the design (and development) of the technology [27]; this might result in more energy moved into proper and genuine participation and a strong alignment of design practices with the values of the groups involved. Additionally, it potentially allows operating in contexts characterised by limited resources. On the other hand, they allow for meshing different technological initiatives [27] which makes it possible to tackle multiple needs.

Additionally, off-the-shelf tools can contribute to the sustainability of the results which it is still an open issue in PD [66], and commons ([47, 78, 87] debate. We argue that proposing off-the-shelf tools is a valuable strategy to overcome some sustainability problems such as maintenance and support. The existence of resources to facilitate their use (e.g. how-to, tutorials, forums) can be pivotal in emancipating participants from researchers’ technical support (as in [68]). In our case, such resources allowed Equilibrio’s organisers to set up the collaborative map and include less tech savvy participants without requiring researchers’ help. For this reason, we are optimistic about their ability to solve technical issues that may occur in the future. Also, having gained a certain degree of skill with the tool, they may decide to use it to support future projects.

We can also observe that after more than one year most participants are using Telegram on a daily or nearly-daily basis. This

<sup>11</sup>The artistic project developed by Equilibrio using Umap is available at: <https://uploads.knightlab.com/storymapjs/976eeb1b939c67f1696328f0192f950c/as-nossas-arvores/index.html>.

suggests that their use of the tool goes beyond the scope of participating in the project's Telegram group, which does not have daily interactions. Moreover, suggesting the adoption of off-the-shelf digital commons allowed Equilibrio to redirect their limited financial resources from the implementation of an ad-hoc technology to the creation of content. On different occasions, different participants expressed that, from their perspective, this represented a better use of their resources.

Additionally, promoting the adoption of off-the-shelf tools can contribute to the sustainability of the tools themselves. By referring to the work by Iversen and Dindler[46], Poderi[65] proposed four approaches - *maintaining, scaling, replicating, evolving* - that support the long-term sustainability of digital commons. We support that the adoption of these tools contributes to scaling as to "increase number of end-users/non-participants [and] new contributors" [65, p. 251.] In our empirical findings, we could observe how the results also go beyond the mere increase of the number of users. In fact, Equilibrio organisers decided to create a new tutorial in Portuguese directly contributing to the community of the digital commons they adopted.

## 5.2 What can be considered a commons? - theoretical considerations

Understanding what can be considered a commons is not trivial. We proposed the categorization of commoning in and through design sided by the specific issues of environment and monopolism as additional layers to reflect on this question. Reflecting on these elements allows locating an off-the-shelf digital tool in the commons-gradient. One additional advantage of this model that we propose as in figure 3 is that it facilitates visualising different tools in the same diagram, allowing for comparing different dimensions. This can be helpful if we need to select one among many tools, in particular if the differences among them are subtle.

The gradient is based on the theoretical considerations we presented in this paper. It includes the distinction between commoning in design - when a piece of technology that embeds in itself commoning practices overlaps with the classic vision of digital commons by Benkler [7] -, and commoning through design, when a piece of technology privileges commoning practices over exploitative models and is more aligned with Bollier's [13, 14] idea of relational commons, which stresses the importance of practices over the goods. The two additional issues we identified (supporting environmental sustainability and contrasting digital monopolies) help to navigate a space where the distinction blurs between what is a commons and what is not a commons. Contrasting dynamics like increased surveillance [94], capitalistic exploitations [82], and monopolistic and lobbying activities [58] is not in itself a commoning practice. However, it contributes to the democratisation of the digital space that can facilitate commoning practices. Digital commoning practice and supporting environmental sustainability are increasingly intertwined [1, 1, 6, 34, 61, 62].

Overall, we want to remark that the distinction often blurs between actual digital commons and tools that can be appropriated to support commoning practices. For example, a platform like Facebook is frequently used to organise and coordinate commoning

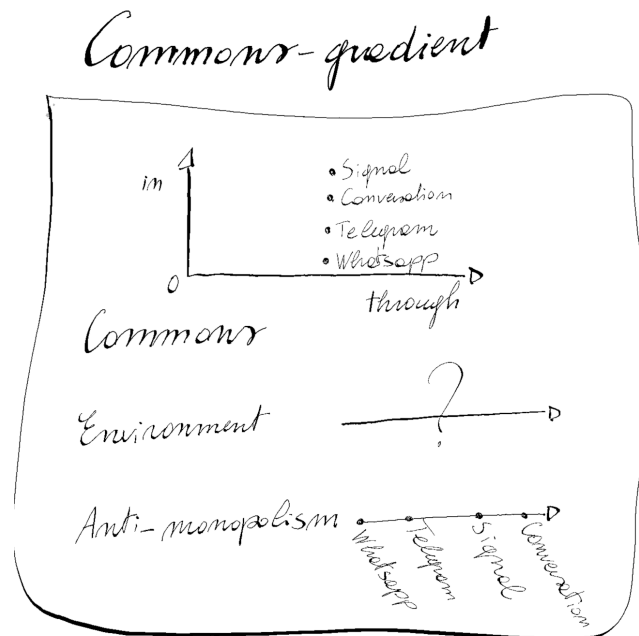


Figure 3: This figure represents how the commons-gradient summarises the reflections on instant messaging apps that we described in section 4.2 and 4.3. Digital tools providing similar services are in different positions in the continuum of the categories we considered (e.g. Signal is stronger than Conversation if we consider *commoning in design* as it is managed by a broad community, but Conversation is stronger than Signal on the *anti-monopolism* side, as it allows for more independence). In this case, we did not have sufficient information on the environmental impact on the different services, and therefore the *environment* continuum remained blank.

practices [60, 70] (commoning thorough design). However, Facebook has not been designed specifically to support commoning practices, and proposing Facebook should be carefully pondered due to its ethical criticism (see e.g. [89]), its strong centralised proprietary model and lobbying activity [58] (big in design issues). Using alternatives that are more commoning-oriented (as could be the Fediverse) would be preferable, but this possibility depends on the availability of the participants to migrate on different and less known platforms. In our project, we faced this issue with instant message services and find ourself in the need to operate a negotiation, therefore discard any Fediverse based solution. Figure 3 presents the commons-gradient scheme populated with chat services based on the reflection we made during the project and that we have discussed in detail in section 4. All these elements cannot be taken as absolutely normative but are orientations that can help to align people's values with their technological choices. Therefore, these elements help make situated choices that contribute to the "big issues" [19] at different degrees, in different moments, and different places.

Questions	Criteria
<b>Finding the tools</b>	
<b>Is it a commons?</b>	<p>The theoretical considerations proposed in this paper can be used to analyse if a tool can be considered a commons. The following sub questions can help conducting the process</p> <p>Is it a commons in or through design?                      Does it foster environmental sustainability?                      Does it offer an alternative to Corporate fatcats?</p> <p>Additionally the following question is an additional criteria:                      Is it still a commons?</p>
<b>When to look for commons?</b>	Recursively throughout the entire process
<b>Where to look for commons?</b>	Building a list of reputable sources (but remaining open to serendipity)
<b>Is it working?</b>	<p>The list of sub-questions we adopted can be used as criteria:</p> <p>Is it still supported?                      Can it be accessed?                      Does it exist in a known language?                      Is it usable?</p>
<b>Selecting the tools based on participants interests and values</b>	
<b>Which function/action?</b>	Based on participants interests - to collect in previous phases of the PD process
<b>Which alternative to choose?</b>	Based on the context
<b>Should we present multiple alternatives to participants?</b>	Tension between time and openness of the process

Table 2: Summary of all the questions we had to face to present off-the-shelf digital commons to our participants.

### 5.3 Which off-the-shelf tools to propose? - practical criteria

By formalising the outcomes of our reflection [75] we propose a set of practical criteria to understand which off-the-shelf tools fostering commoning can be proposed to a group. This work is part of broader research for which we engaged in a relationship with Equilibrio for almost two years. Even though these questions result from our reflexivity, it is essential to consider them as emerging from a specific phase in this broader context. Table 2 summarises all the questions we had to face: an extensive account of the operationalization of these questions can be found in sections 4.2 and 4.3. Some of them may appear quite trivial, but, in our experience, they were all fundamental to be able to present viable solutions to our participants.

## 6 LIMITATIONS AND CONCLUSIONS

In this paper, we proposed that off-the-shelf tools can promote commoning by supporting the sustainability of the results. To this end, we developed theoretical considerations and practical criteria to understand how a tool supports commoning practices.

The contribution of this paper should not be considered as a final and comprehensive account on that matter, rather as a set of initial hints that need to be declined in the practice and eventually

widened. The commons-gradient is not a definitive analytical framework but could be enriched by further reflections. In particular, the issues "environment" and "anti-monopolism" reflect focal aspects of the global debate that connects to the debate on commons, but further speculations could identify additional issues. The practical criteria, as well as the use of off-the-shelf digital commons, need to be backed up by future studies carried on in different contexts; future studies could led to adding or changing the practical criteria, or come to different conclusions on the sustainability of off-the-shelf tools. We conclude with two further reflections.

*What is included and excluded from the commons?* Being a commons is not an ontological quality but is a relational property depending on the context, both looking at the practices of the participants and the spectrum of digital alternatives globally available. The distinction is not a clear-cut one but a continuum gamut of gradients. The various theoretical considerations (sections 3.2 and 5.2) and the questions on finding the tools 2 proposed in this paper can help orient oneself in this continuum. Further research is needed in other contexts and within different projects, to widen the reflection on how to practically operationalize commoning practices and digital commons.

*"Who gets to decide?"* This question cannot be answered by identifying actors, but rather it requires engaging with the dynamics of the groups in relation to the context and the tools already in use. In our research, the case of instant messaging services is quite

emblematic, as, at the beginning of our research, most of our participants relied exclusively on WhatsApp. Conversation was the tool that better fit an unquestionable definition of commons, however, we had to exclude it because the requirements of its usage did not fit the context. On the contrary, both Telegram and Signal can be placed somewhere in the middle of the common-gradient, and the choice of Telegram over Signal was negotiated. The amplitude of the negotiation process depends on many contextual factors. In our case, as most participants were not specifically passionate about digital technologies, we kept the last part of the process open only when the information was insufficient to decide. This choice was oriented by a pragmatic attempt of keeping a sustainable balance between how much the process was open and how much time and effort it required from participants. Future research can, for example, help enlighten the relationship between the characteristics of the participants and the specific technological choices made during a process.

In conclusion, our paper positions itself as a first contribution to the operationalization of digital commons when engaging in the practical activities of a Participatory Design process in which the competencies of the design researchers are called upon to support the participants' exploration and adoption of available technologies.

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## REFERENCES

- [1] [n.d.]. *Study about the impact of open source software and hardware on technological independence, competitiveness and innovation in the EU economy | Shaping Europe's digital future*. Technical Report Publication 06 September 2021. <https://digital-strategy.ec.europa.eu/en/library/study-about-impact-open-source-software-and-hardware-technological-independence-competitiveness-and>
- [2] Shana Agid and Yoko Akama. 2020. Reflexive account-giving through "practice notations": plural dimensions and dynamics of infrastructuring. In *Proceedings of the 16th Participatory Design Conference 2020 - Participation(s) Otherwise - Volume 2 (PDC '20)*. Association for Computing Machinery, New York, NY, USA, 164–169. <https://doi.org/10.1145/3384772.3385136>
- [3] Gabriela Avram, Jaz Hee-jeong Choi, Stefano De Paoli, Ann Light, Peter Lyle, and Maurizio Teli. 2017. Collaborative Economies: From Sharing to Caring. In *Proceedings of the 8th International Conference on Communities and Technologies (C&T '17)*. ACM, New York, NY, USA, 305–307. <https://doi.org/10.1145/3083671.3083712> event-place: Troyes, France.
- [4] Ellen Balka and Nicki Kahnemou. 2004. Technology trouble? talk to us: findings from an ethnographic field study. In *Proceedings of the eighth conference on Participatory design: Artful integration: interweaving media, materials and practices - Volume 1 (PDC 04)*. Association for Computing Machinery, New York, NY, USA, 224–234. <https://doi.org/10.1145/1011870.1011896>
- [5] Chiara Bassetti, Mariacristina Sciannamblo, Peter Lyle, Maurizio Teli, Stefano De Paoli, and Antonella De Angeli. 2019. Co-designing for common values: creating hybrid spaces to nurture autonomous cooperation. *CoDesign* 15, 3 (July 2019), 256–271. <https://doi.org/10.1080/15710882.2019.1637897>
- [6] Yochai Benkler. 2003. The political economy of commons. *Upgrade: The European Journal for the Informatics Professional* 4, 3 (2003), 6–9.
- [7] Yochai Benkler. 2007. *The Wealth of Networks: How Social Production Transforms Markets and Freedom* (9/23/07 edition ed.). Yale University Press, New Haven, Conn.
- [8] Mela Bettega, Raul Masu, and Vera Lucia Alves Pereira Diogo. 2021. Collaborative Economy in Portugal: the Recent Evolution. (2021).
- [9] Mela Bettega, Raul Masu, and Maurizio Teli. 2021. "It's like a GPS community tool": Tactics to foster Digital Commons through Artifact Ecology. In *Designing Interactive Systems Conference 2021 (DIS '21)*. Association for Computing Machinery, New York, NY, USA, 1710–1725. <https://doi.org/10.1145/3461778.3462034>
- [10] Erling Björgvinsson and Per-Anders Hillgren. 2004. On the spot experiments within healthcare. In *Proceedings of the eighth conference on Participatory design: Artful integration: interweaving media, materials and practices - Volume 1 (PDC 04)*. Association for Computing Machinery, New York, NY, USA, 93–101. <https://doi.org/10.1145/1011870.1011882>
- [11] Susanne Boedker and Clemens Nylandstedt Klokose. 2011. The Human–Artifact Model: An Activity Theoretical Approach to Artifact Ecologies. *Human–Computer Interaction* 26, 4 (Dec. 2011), 315–371. <https://doi.org/10.1080/07370024.2011.626709> Publisher: Taylor & Francis \_eprint: <https://doi.org/10.1080/07370024.2011.626709>.
- [12] Stella Boess, Sacha Silvester, Elles de Wal, and Onno de Wal. 2018. Acting from a participatory attitude in a networked collaboration. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–6. <https://doi.org/10.1145/3210604.3210642>
- [13] David Bollier and Silke Helfrich. 2014. *The wealth of the commons: A world beyond market and state*. Levellers Press.
- [14] David Bollier and Silke Helfrich. 2019. *Free, fair, and alive: The insurgent power of the commons*. New Society Publishers.
- [15] Andrea Botero, Sanna Marttila, Giacomo Poderi, Joanna Saad-Sulonen, Anna Seravalli, Maurizio Teli, and Frederick M.C van Amstel. 2020. COMMON-ING DESIGN AND DESIGNING COMMONS. In *Proceedings of the 16th Participatory Design Conference 2020 - Participation(s) Otherwise - Volume 2 (PDC '20)*. Association for Computing Machinery, New York, NY, USA, 178–180. <https://doi.org/10.1145/3384772.3385162>
- [16] Virginia Braun and Victoria Clarke. 2006. Using thematic analysis in psychology. *Qualitative Research in Psychology* 3, 2 (2006), 77–101. <https://doi.org/10.1191/1478088706qp0630a> arXiv:<https://www.tandfonline.com/doi/pdf/10.1191/1478088706qp0630a>
- [17] Alice V. Brown, Jaz Hee-Jeong Choi, and Jane Shakespear-Finch. 2019. Care towards posttraumatic growth in the era of digital economy. *CoDesign* 15, 3 (July 2019), 212–227. <https://doi.org/10.1080/15710882.2019.1631350> Publisher: Taylor & Francis \_eprint: <https://doi.org/10.1080/15710882.2019.1631350>.
- [18] Maurizio Bruglieri, Diego Ciccarelli, Alberto Colorni, and Alessandro Luè. 2011. PoliUniPool: a carpooling system for universities. *Procedia - Social and Behavioral Sciences* 20 (2011), 558–567. <https://doi.org/10.1016/j.sbspro.2011.08.062> The State of the Art in the European Quantitative Oriented Transportation and Logistics Research – 14th Euro Working Group on Transportation and 26th Mini Euro Conference and 1st European Scientific Conference on Air Transport.
- [19] Susanne Bødker and Morten Kyng. 2018. Participatory Design that Matters&#x2014;Facing the Big Issues. *ACM Transactions on Computer-Human Interaction* 25, 1 (Feb. 2018), 4:1–4:31. <https://doi.org/10.1145/3152421>
- [20] Rachel C Smith, Claus Bossen, Christian Dindler, and Ole Sejer Iversen. 2020. When Participatory Design Becomes Policy: Technology Comprehension in Danish Education. In *Proceedings of the 16th Participatory Design Conference 2020 - Participation(s) Otherwise - Volume 1 (PDC '20)*. Association for Computing Machinery, New York, NY, USA, 148–158. <https://doi.org/10.1145/3385010.3385011>
- [21] Andrea Capaccioli, Giacomo Poderi, Mela Bettega, and Vincenzo D'Andrea. 2016. Participatory infrastructuring of community energy. In *Proceedings of the 14th Participatory Design Conference: Short Papers, Interactive Exhibitions, Workshops - Volume 2 (PDC '16)*. Association for Computing Machinery, New York, NY, USA, 9–12. <https://doi.org/10.1145/2948076.2948089>
- [22] InduShobha Chengalur-Smith, Anna Sidorova, and Sherae L Daniel. 2010. Sustainability of free/libre open source projects: A longitudinal study. *Journal of the Association for Information Systems* 11, 11 (2010), 5.
- [23] Roberto Cibin, Sarah Robinson, Nicola J. Bidwell, Conor Linehan, Laura Maye, Nadia Pantidi, and Maurizio Teli. 2021. Land, water and sun: Tuning into socio-ecological relations in radio design. In *Designing interactive systems conference 2021 (DIS '21)*. Association for Computing Machinery, New York, NY, USA, 1954–1969. <https://doi.org/10.1145/3461778.3462104> Number of pages: 16 Place: Virtual Event, USA.
- [24] Nazli Cila, Gabriele Ferri, Martijn de Waal, Inte Gloerich, and Tara Karpinski. 2020. The Blockchain and the Commons: Dilemmas in the Design of Local Platforms. In *Proceedings of the 2020 CHI Conference on Human Factors in Computing Systems (CHI '20)*. Association for Computing Machinery, New York, NY, USA, 1–14. <https://doi.org/10.1145/3313831.3376660>
- [25] Rachel Clarke, Sara Heitlinger, Marcus Foth, Carl DiSalvo, Ann Light, and Laura Forlano. 2018. More-than-human urban futures: speculative participatory design to avoid ecodical smart cities. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–4. <https://doi.org/10.1145/3210604.3210641>

- [26] Rachel Clarke, Sara Heitlinger, Ann Light, Laura Forlano, Marcus Foth, and Carl DiSalvo. 2019. More-than-human participation: design for sustainable smart city futures. *Interactions* 26, 3 (April 2019), 60–63. <https://doi.org/10.1145/3219075>
- [27] Janet Davis. 2012. Early experiences with participation in persuasive technology design. In *Proceedings of the 12th Participatory Design Conference: Research Papers - Volume 1 (PDC '12)*. Association for Computing Machinery, New York, NY, USA, 119–128. <https://doi.org/10.1145/2347635.2347653>
- [28] M. De Angelis. 2019. Commons. In *Pluriverse: A Post-Development Dictionary*, Ashish Kothari, Ariel Salleh, Arturo Escobar, Federico Demaria, and Alberto Acosta (Eds.). Tulika Books. Pages: 384 Pages.
- [29] Yvonne Dittrich, Sara Eriksen, and Christina Hansson. [n. d.]. PD in the Wild; Evolving Practices of Design in Use. ([n. d.]), 11.
- [30] Markéta Dolejšová, Sjeff van Gaalen, Danielle Wilde, Paul Graham Raven, Sara Heitlinger, and Ann Light. 2020. Designing with More-than-Human Food Practices for Climate-Resilience. In *Companion Publication of the 2020 ACM Designing Interactive Systems Conference (DIS' 20 Companion)*. Association for Computing Machinery, New York, NY, USA, 381–384. <https://doi.org/10.1145/3393914.3395909>
- [31] Enrico Dorigatti and Raul Masu. 2022. Circuit Bending and Environmental Sustainability: Current Situation and Steps Forward. In *Proceedings of the International Conference on New Interfaces for Musical Expression*. Auckland, New Zealand.
- [32] Mélanie Dulong de Rosnay and Felix Stalder. 2020. Digital commons. *Internet Policy Review* 9, 4 (2020), 1–22.
- [33] Kristofer Erickson, Felix Rodriguez Perez, and Jesus Rodriguez Perez. 2018. What is the commons worth? Estimating the value of wikimedia imagery by observing downstream use. In *Proceedings of the 14th international symposium on open collaboration (OpenSym '18)*. Association for Computing Machinery, New York, NY, USA. <https://doi.org/10.1145/3233391.3233533> Number of pages: 6 Place: Paris, France tex.articleno: 9.
- [34] David Franquesa and Leandro Navarro. 2018. Devices as a commons: limits to premature recycling. In *Proceedings of the 2018 Workshop on Computing within Limits (LIMITS '18)*. Association for Computing Machinery, New York, NY, USA, 1–10. <https://doi.org/10.1145/3232617.3232624>
- [35] Christian Fuchs. 2021. The digital commons and the digital public sphere: How to advance digital democracy today. *Westminster Papers in Communication and Culture* 16, 1 (2021).
- [36] Gustavo A. García-López, Ursula Lang, and Neera Singh. 2021. Commons, Commoning and Co-Becoming: Nurturing Life-in-Common and Post-Capitalist Futures (An Introduction to the Theme Issue). *Environment and Planning E: Nature and Space* 4, 4 (Dec. 2021), 1199–1216. <https://doi.org/10.1177/25148486211051081> Publisher: SAGE Publications Ltd STM.
- [37] Naska Goagoses, Asnath Paula Kambunga, and Heike Winschiers-Theophilus. 2018. Enhancing commitment to participatory design initiatives. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–5. <https://doi.org/10.1145/3210604.3210613>
- [38] Ben Hagenaars. 2018. Story LAB: documenting design projects as open scenarios. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–2. <https://doi.org/10.1145/3210604.3214360>
- [39] Nicolai Brodersen Hansen, Christian Dindler, Kim Halskov, Ole Sejer Iversen, Claus Bossen, Ditte Amund Basballe, and Ben Schouten. 2019. How Participatory Design Works: Mechanisms and Effects. In *Proceedings of the 31st Australian Conference on Human-Computer-Interaction (OZCHI'19)*. Association for Computing Machinery, New York, NY, USA, 30–41. <https://doi.org/10.1145/3369457.3369460> tex.ids= hansen2019participatory event-place: Fremantle, WA, Australia.
- [40] Nicolai Brodersen Hansen, Gwen Klerks, Maria Menendez Blanco, Laura Maye, Angelika Strohmayer, Martijn de Waal, and Ben Schouten. 2020. Making Civic Initiatives Last: Ecosystems, Technologies, Approaches and Challenges. In *Companion Publication of the 2020 ACM Designing Interactive Systems Conference (DIS' 20 Companion)*. Association for Computing Machinery, New York, NY, USA, 433–436. <https://doi.org/10.1145/3393914.3395921> event-place: Eindhoven, Netherlands.
- [41] Sara Heitlinger, Nick Bryan-Kinns, and Rob Comber. 2018. Connected seeds and sensors: co-designing internet of things for sustainable smart cities with urban food-growing communities. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–5. <https://doi.org/10.1145/3210604.3210620>
- [42] Sara Heitlinger, Rachel Clarke, Adrian K. Clear, Simran Chopra, and Özge Dilaver. 2019. Co-Creating "Smart" Sustainable Food Futures with Urban Food Growers. In *Proceedings of the 9th International Conference on Communities & Technologies - Transforming Communities (C&T'19)*. Association for Computing Machinery, New York, NY, USA, 114–120. <https://doi.org/10.1145/3328320.3328399>
- [43] Sara Heitlinger, Marcus Foth, Rachel Clarke, Carl DiSalvo, Ann Light, and Laura Forlano. 2018. Avoiding ecodical smart cities: participatory design for more-than-human futures. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–3. <https://doi.org/10.1145/3210604.3210619>
- [44] Charlotte Hess and Elinor Ostrom (Eds.). 2006. *Understanding Knowledge as a Commons: From Theory to Practice*. MIT Press, Cambridge, MA, USA.
- [45] Jenni Huttunen and Maria Joutsenvirta. 2019. Monies, economies and democracy: cultivating ambivalence in the co-design of digital currencies. *CoDesign* 15, 3 (July 2019), 228–242. <https://doi.org/10.1080/15710882.2019.1631352> Publisher: Taylor & Francis \_eprint: <https://doi.org/10.1080/15710882.2019.1631352>
- [46] Ole Sejer Iversen and Christian Dindler. 2014. Sustaining participatory design initiatives. *CoDesign* 10, 3–4 (July 2014), 153–170. <https://doi.org/10.1080/15710882.2014.963124> Publisher: Taylor & Francis \_eprint: <https://doi.org/10.1080/15710882.2014.963124>
- [47] Nicola J Bidwell. 2020. Wireless in the Weather-world and Community Networks Made to Last. In *Proceedings of the 16th Participatory Design Conference 2020 - Participation(s) Otherwise - Volume 1 (PDC '20)*. Association for Computing Machinery, New York, NY, USA, 126–136. <https://doi.org/10.1145/3385010.3385014>
- [48] Ann Light. 2018. Writing PD: accounting for socially-engaged research. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–5. <https://doi.org/10.1145/3210604.3210615>
- [49] Ann Light and Clodagh Miskelly. 2019. Platforms, Scales and Networks: Meshing a Local Sustainable Sharing Economy. *Computer Supported Cooperative Work (CSCW)* 28, 3 (June 2019), 591–626. <https://doi.org/10.1007/s10606-019-09352-1>
- [50] Ann Light and Anna Seravalli. 2019. The breakdown of the municipality as caring platform: lessons for co-design and co-learning in the age of platform capitalism. *CoDesign* 15, 3 (July 2019), 192–211. <https://doi.org/10.1080/15710882.2019.1631354> Publisher: Taylor & Francis \_eprint: <https://doi.org/10.1080/15710882.2019.1631354>
- [51] Thomas Lodato and Carl DiSalvo. 2018. Institutional constraints: the forms and limits of participatory design in the public realm. In *Proceedings of the 15th Participatory Design Conference: Full Papers - Volume 1 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–12. <https://doi.org/10.1145/3210586.3210595> tex.ids= lodatoInstitutionalConstraintsForms2018 event-place: Hasselt and Genk, Belgium.
- [52] Peter Lyle, Mariacristina Sciannamblo, and Maurizio Teli. 2018. Fostering Commonfare. Infrastructuring Autonomous Social Collaboration. In *Proceedings of the 2018 CHI Conference on Human Factors in Computing Systems (CHI '18)*. Association for Computing Machinery, New York, NY, USA, 1–12. <https://doi.org/10.1145/3173574.3174026>
- [53] Jennifer C. Mankoff, Eli Blevis, Alan Borning, Batya Friedman, Susan R. Fussell, Jay Hasbrouck, Allison Woodruff, and Phoebe Sengers. 2007. Environmental sustainability and interaction. In *CHI '07 Extended Abstracts on Human Factors in Computing Systems (CHI EA '07)*. Association for Computing Machinery, New York, NY, USA, 2121–2124. <https://doi.org/10.1145/1240866.1240963>
- [54] Sanna Marttila, Andrea Botero, and Joanna Saad-Sulonen. 2014. Towards commons design in participatory design. In *Proceedings of the 13th Participatory Design Conference: Short Papers, Industry Cases, Workshop Descriptions, Doctoral Consortium papers, and Keynote abstracts - Volume 2 (PDC '14)*. Association for Computing Machinery, New York, NY, USA, 9–12. <https://doi.org/10.1145/2662155.2662187> tex.ids= marttilaCommonsDesignParticipatory2014, marttila-CommonsDesignParticipatory2014a event-place: Windhoek, Namibia.
- [55] Sanna Marttila, Elisabet M Nilsson, and Anna Seravalli. 2014. Opening production: commons and commons. In *Making futures: marginal notes on innovation, design, and democracy Pelle Ehn, Elisabet M. Nilsson and Richard Topgaard (eds.)*. MIT Press, 87–98.
- [56] Raul Masu, Adam Pultz Melbye, John Sullivan, and Alexander Refsum Jensenius. 2021. NIME and the Environment: Toward a More Sustainable NIME Practice. In *Proceedings of the International Conference on New Interfaces for Musical Expression*. Shanghai, China. <https://doi.org/10.21428/92fbeb44.5725ad8f>
- [57] Raul Masu and Fabio Morreale. 2021. Composing by Hacking: Technology Appropriation as a Pedagogical Tool for Electronic Music. In *Teaching Electronic Music*. Routledge, 157–171.
- [58] Max Bank, Felix Duffy, Verena Leyendecker, and Margarida Silva. 2021. *The lobby network - Big Tech's web of influence in the EU.pdf*. Technical Report. Corporate Europe Observatory and LobbyControl eV, Brussels and Cologne.
- [59] James Meadway. 2020. Creating a digital commons. (2020).
- [60] Gaia Mosconi, Matthias Korn, Christian Reuter, Peter Tolmie, Maurizio Teli, and Volkmar Pipek. 2017. From Facebook to the Neighbourhood: Infrastructuring of Hybrid Community Engagement. *Computer Supported Cooperative Work (CSCW)* 26, 4 (Dec. 2017), 959–1003. <https://doi.org/10.1007/s10606-017-9291-z>
- [61] S Nanayakkara. 2017. Impact of free and open-source software paradigm for environmental sustainability-case study in higher education sector. *International Journal of Research in Electronics and Computer Engineering* 5, 4 (2017), 174–188.
- [62] Elinor Ostrom. 1990. *Governing the commons: The evolution of institutions for collective action*. Cambridge university press.
- [63] Teresa Palmieri, Liesbeth Huybrechts, Oswald Devish, and Roel De Ridder. 2018. Everyone shares in hasselt: a perspective on the political potential of spatial

- commoning. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–3. <https://doi.org/10.1145/3210604.3214359>
- [64] Ida Nilstad Pettersen, Hanne Cecilie Geirbo, and Hanne Johnsrud. 2018. The tree as method: co-creating with urban ecosystems. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–6. <https://doi.org/10.1145/3210604.3210653>
- [65] Giacomo Poderi. 2019. Sustaining platforms as commons: perspectives on participation, infrastructure, and governance. *CoDesign* 15, 3 (July 2019), 243–255. <https://doi.org/10.1080/15710882.2019.1631351> Publisher: Taylor & Francis eprint: <https://doi.org/10.1080/15710882.2019.1631351>
- [66] Giacomo Poderi and Yvonne Dittrich. 2018. Participatory design and sustainability: a literature review of PDC proceedings. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–5. <https://doi.org/10.1145/3210604.3210624>
- [67] Robert Procter, T. Binder, J. Gregory, and I. Wagner. 2002. Promises, Premises and Risks: Sharing Responsibilities, Working Up Trust and Sustaining Commitment in Participatory Design Projects. In *Proceedings of the Participatory Design Conference*. Association for Computing Machinery. [https://www.research.manchester.ac.uk/portal/en/publications/promises-premises-and-risks-sharing-responsibilities-working-up-trust-and-sustaining-commitment-in-participatory-design-projects\(e322c122-5299-4972-967e-1b26bc6c3537\).html](https://www.research.manchester.ac.uk/portal/en/publications/promises-premises-and-risks-sharing-responsibilities-working-up-trust-and-sustaining-commitment-in-participatory-design-projects(e322c122-5299-4972-967e-1b26bc6c3537).html)
- [68] Sarah Robinson, Nicola J. Bidwell, Laura Maye, Nadia Pantidi, and Conor Linehan. 2020. Participation through substituting and refusing. In *Proceedings of the 16th Participatory Design Conference 2020 - Participation(s) Otherwise - Volume 2 (PDC '20)*. Association for Computing Machinery, New York, NY, USA, 143–147. <https://doi.org/10.1145/3384772.3385148>
- [69] David Roedl, William Odom, and Eli Blevis. 2017. Three principles of sustainable interaction design, revisited. *Digital Technology and Sustainability: Embracing the Paradox* (2017).
- [70] Rossito, Chiara, Lampini, Airi, Light, Ann, Diogo, Vera, Bernat, Aniko, and Travlou, Penny. 2021. Why Are We Still Using Facebook? The Platform Paradox in Collaborative Community Initiatives. In *Becoming a Platform in Europe – On the Governance of the Collaborative Economy*, Maurizio Teli and Chiara Bassetti (Eds.). Now Publishers, 90–109. [10.1561/9781680838411.ch5](https://doi.org/10.1561/9781680838411.ch5)
- [71] Santiago Sanchez Guzman, Rudolf Giffinger, Leonardo Parra-Agudelo, and Antonija Bogadi. 2020. Open Participatory Design and Digital Tools for Inclusive and Resilient Development: Full-Day Workshop. In *Proceedings of the 16th Participatory Design Conference 2020 - Participation(s) Otherwise - Volume 2 (PDC '20)*. Association for Computing Machinery, New York, NY, USA, 185–187. <https://doi.org/10.1145/3384772.3385164>
- [72] Trebor Scholz and Nathan Schneider. 2017. *Ours to hack and to own: The rise of platform cooperativism, a new vision for the future of work and a fairer internet*. OR books.
- [73] Nico Schrijver. 2016. Managing the global commons: common good or common sink? *Third World Quarterly* 37, 7 (2016), 1252–1267.
- [74] Ermelindo Schultz, Laura Sanchez Garcia, Laís Affornali Fernandes, Mateus Ribamar Paixão, Fernanda Kawasaki, and Roberto Pereira. 2020. Cultivating Creative Coexistence(s): towards a critical education for creativity praxis to construct fairer human coexistences. In *Proceedings of the 16th Participatory Design Conference 2020 - Participation(s) Otherwise - Volume 1 (PDC '20)*. Association for Computing Machinery, New York, NY, USA, 33–43. <https://doi.org/10.1145/3385010.3385019>
- [75] Donald A. Schön. 2017. *The Reflective Practitioner: How Professionals Think in Action*. Routledge, London. <https://doi.org/10.4324/9781315237473>
- [76] Mariacristina Sciannamblo, Marisa Leavitt Cohn, Peter Lyle, and Maurizio Teli. 2021. Caring and Commoning as Cooperative Work: A Case Study in Europe. *Proceedings of the ACM on Human-Computer Interaction* 5, CSCW1 (April 2021), 126:1–126:26. <https://doi.org/10.1145/3449200>
- [77] Anna Seravalli. 2014. *Making Commons: attempts at composing prospects in the opening of production*. Ph. D. Dissertation. Malmö University.
- [78] Anna Seravalli. 2018. Infrastructuring Urban Commons over Time: Learnings from Two Cases. In *Proceedings of the 15th Participatory Design Conference: Full Papers - Volume 1 (PDC '18)*. ACM, New York, NY, USA, 4:1–4:11. <https://doi.org/10.1145/3210586.3210593> tex.ids= seravalliinfrastructuringUrbanCommons2018a event-place: Hasselt and Genk, Belgium.
- [79] Jesper Simonsen and Morten Hertzum. 2012. Real-use evaluation of effects: emergency departments aiming for 'Warm Hands'. In *Proceedings of the 12th Participatory Design Conference: Exploratory Papers, Workshop Descriptions, Industry Cases - Volume 2 (PDC '12)*. Association for Computing Machinery, New York, NY, USA, 69–72. <https://doi.org/10.1145/2348144.2348166>
- [80] Jesper Simonsen and Toni Robertson. 2012. *Routledge International Handbook of Participatory Design*. Routledge. Google-Books-ID: ttzfCgAAQBAJ.
- [81] Ricardo Sosa. 2020. Indigenous Worldviews to Inform Participatory Creativity. In *Proceedings of the 16th Participatory Design Conference 2020 - Participation(s) Otherwise - Volume 2 (PDC '20)*. Association for Computing Machinery, New York, NY, USA, 72–75. <https://doi.org/10.1145/3384772.3385127>
- [82] Nick Srmicek. 2017. *Platform capitalism*. John Wiley & Sons.
- [83] Maurizio Teli. 2015. Computing and the common: hints of a new utopia in participatory design. In *Proceedings of The Fifth Decennial Aarhus Conference on Critical Alternatives (CA '15)*. Aarhus University Press, Aarhus N, 17–20. <https://doi.org/10.7146/aahec.v1i1.21318>
- [84] Maurizio Teli, Silvia Bordin, María Menéndez Blanco, Giusi Orabona, and Antonella De Angeli. 2015. Public design of digital commons in urban places: A case study. *International Journal of Human-Computer Studies* 81 (Sept. 2015), 17–30. <https://doi.org/10.1016/j.ijhcs.2015.02.003>
- [85] Maurizio Teli, Angela Di Fiore, and Vincenzo D'Andrea. 2016. Computing and the common: an empirical case of participatory design today. In *Proceedings of the 14th Participatory Design Conference: Full papers - Volume 1 (PDC '16)*. Association for Computing Machinery, New York, NY, USA, 1–10. <https://doi.org/10.1145/2940299.2940312>
- [86] Maurizio Teli, Marcus Foth, Mariacristina Sciannamblo, Irina Anastasiu, and Peter Lyle. 2020. Tales of institutioning and commoning: Participatory design processes with a strategic and tactical perspective. In *Proceedings of the 16th Participatory Design Conference (PDC 2020)*, Vol. 1. Association for Computing Machinery, 159–171. <https://doi.org/10.1145/3385010.3385020>
- [87] Maurizio Teli, Peter Lyle, and Mariacristina Sciannamblo. 2018. Institutioning the common: the case of commonfare. In *Proceedings of the 15th Participatory Design Conference: Full Papers - Volume 1 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–11. <https://doi.org/10.1145/3210586.3210590>
- [88] Austin L. Toombs. 2017. Hackerspace tropes, identities, and community values. In *Proceedings of the 2017 conference on designing interactive systems (DIS '17)*. Association for Computing Machinery, New York, NY, USA, 1079–1091. <https://doi.org/10.1145/3064663.3064760> Number of pages: 13 Place: Edinburgh, United Kingdom.
- [89] Siva Vaidhyanathan. 2021. Leaks just exposed how toxic Facebook and Instagram are to teen girls and, well, everyone. *The Guardian* (Sept. 2021). <https://www.theguardian.com/commentisfree/2021/sep/18/facebook-instagram-zuckerberg-teenagers>
- [90] José Van Dijk, Thomas Poell, and Martijn De Waal. 2018. *The platform society: Public values in a connective world*. Oxford University Press.
- [91] Colin C. Venters, Rafael Capilla, Stefanie Betz, Birgit Penzenstadler, Tom Crick, Steve Crouch, Elisa Yumi Nakagawa, Christoph Becker, and Carlos Carrillo. 2018. Software sustainability: Research and practice from a software architecture viewpoint. *Journal of Systems and Software* 138 (2018), 174–188. <https://doi.org/10.1016/j.jss.2017.12.026>
- [92] Kristof Vrancken. 2018. mijnKOOL, organic photography as a participatory design method. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–3. <https://doi.org/10.1145/3210604.3214364>
- [93] Signe Louise Yndigegn, Lone Malmborg, and Eva Brandt. 2018. Codesigning with public partners: controversies and agonism. In *Proceedings of the 15th Participatory Design Conference: Short Papers, Situated Actions, Workshops and Tutorial - Volume 2 (PDC '18)*. Association for Computing Machinery, New York, NY, USA, 1–4. <https://doi.org/10.1145/3210604.3210651>
- [94] Shoshana Zuboff. 2019. *The age of surveillance capitalism: The fight for a human future at the new frontier of power: Barack Obama's books of 2019*. Profile books.