Infrastructuring Urban Commons over Time: Learnings from Two Cases

Full Paper[†]

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ABSTRACT

This paper contributes to the understanding of urban commons and how they might be (co)-designed. Insights from two cases are used to articulate how urban commons develop over time and to discuss how the approach of *infrastructuring* can enable urban commoning on a long-term basis. First, an overview of commons and urban commons is provided with a special focus on *commoning*, as in, the understanding of commons as an ongoing process rather than a stable arrangement. Thereafter, the paper gives an overview of the participatory design community's findings about co-designing commons, with infrastructuring proposed as a possible approach. By looking at the development of two urban commons over time, the paper tentatively presents an understanding of urban commoning. This emerges as a process that entails the exploration, reification, and reworking of collaborative arrangements over time. It is a process that requires transparency and accountability, and its transformative potential in relation to urban governance should be carefully considered. From these findings, the paper suggests that prolonged infrastructuring efforts for urban commons need to: (1) foster the understanding of the temporal and fallible nature of arrangements; (2) support accountability and transparency over time; (3) recognize and address the installed base; and (4) articulate democratic and governance aspects in commoning.

CCS CONCEPTS

• **Human-centered computing** → **Interaction Design** → Participatory design

KEYWORDS

Urban commons; urban commoning; infrastructuring; installed base

1 INTRODUCTION

In recent years, the participatory design /co-design[1] community has been increasingly interested in notions of commons and commoning. This interest has arisen from the engagement of co-designers with commons and new commons [28,14], meaning the shared resources which are used in (and in some cases, generated through) collaborative forms of value production, for example, cultural commons [21,22,24], digital commons [40,41], commons-based production, [33] and urban commons [34,23].

Commons represent an alternative way to organize the property of and access to resources beyond the private and public model [28]. They are based on collaborative arrangements in which participants access, use, and maintain shared resources and collectively decide how to accomplish this [28]. Commons can thus be understood as collaborative arrangements for value production processes that are based on participatory principles.

The collaborative and participatory nature of commons resonates well with co-design aspirations [20], and in recent years, several co-design researchers have been exploring commons in theory and in practice [20,22,23,24,33,34, 35,39,40,41].

In some of these explorations, commons are proposed as a possible new utopia for Participatory Design [39]. This proposal builds on the vision that collaborative ways of using and accessing resources might be the basis for more sustainable and fair ways of organizing the economy and society [3,4,12].

The interest and enthusiasm about commons is also growing within the overall design research community, particularly, among researchers who explore how design can contribute to the creation of a more sustainable and fair society [1,10,36].

When it comes to how to (co-)design commons, infrastructuring has been repeatedly proposed as a possible approach [22,24,33]. This article contributes to advance the understanding of infrastructuring urban commons. It does so by reflecting on the development of two urban commons over time and the

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[1] In this paper, "participatory design" and "co-design" are understood and used as synonymous.

challenges that emerged along the way in relation to the arrangements, the participants' role, and democratic aspects.

First, the article provides an overview of commons and urban commons. Thereafter, it focuses on how infrastructuring has been discussed as an approach for commons. It then introduces two cases of urban commons (a makerspace[2] and a service for waste handling in the city of Malmö, Sweden) and describes their commoning processes over time. From the two cases, urban commoning is understood as a process that entails the exploration, reification, and reworking of collaborative arrangements. From this understanding, the article suggests some aspects that might be important to consider when infrastructuring for urban commons over time.

2 FROM TRADITIONAL COMMONS TO URBAN COMMONING

2.1 (Urban) commons: collaborative arrangements with a transformative potential?

The notion of commons emerged from the studies of common-pool resources, as in, natural and physical resources whose access is difficult to control and which require some form of maintenance over time [28]. These resources support only limited access at a single point in time, and they deplete through use. Examples of common-pool resources are fisheries, irrigation systems, and forests. Ostrom and her group [28] have been studying cases where these resources were successfully accessed and maintained through the establishment of self-organized collaborative arrangements (i.e. rules and organizational forms) among users. Ostrom's notion of commons refers to these self-organized collaborative arrangements, in which collective action is at play to access and preserve a shared resource [28]. In recent years, commons have been used to describe a growing number of initiatives in which the sharing (of resources) and collaboration (for their creation, use, and maintenance) play a key role. These so-called new commons [14] vary greatly in relation to what kind of resource is shared and how the collaborative arrangement is organized. Today, the concept of commons is used to describe different kinds of initiatives where sharing (of different kinds of resources) and collaboration (among participants) enable processes of value production [3] and the management and preservation of different kinds of resources [4]. The emergence of new commons has been accompanied by discourses that frame commons as a paradigm for the creation of a more sustainable and fair society [4]. Here, the focus is on the transformative potential of commons [19] as a concept that challenges contemporary perspectives on property, production, and governance, and that might have the potential to open up for alternative ways of imagining and organizing economy and society [3,4].

Among the new commons, a growing interest has been developing around urban commons [8], a notion that is used to describe collaborative value production arrangements within the urban context. These initiatives entail alliances across sectors for the maintenance and development of different kinds of urban resources like parks, buildings, or even neighborhoods [8]. Urban commons are discussed as specific collaborative arrangements to manage urban resources [8] and as a way to realize "the right to the city" [25], which is the right for people to not only inhabit the city they live in but also shape and decide over its matters [13]. Thus, urban commons are often discussed as a matter of experimenting with and promoting more participative and inclusive forms of urban governance [9].

New commons are understood as both collaborative arrangements and transformative forces. Rodotá warned about the risks of this duality in looking at new commons:

"'The democracy of the commons' cannot be conceived as a catch-all process. I am very suspicious towards the mystic of the 'common' as the sole category for a progressive social and political action toward a metaphysic vision irrespective of the history and of the social dynamics. We must escape the temptation of the extension of the qualification as commons to every good or service. We are risking the inflation. If all is a common then nothing is a common" [32,p.4]

Along a similar line, Hess and Ostrom [15] point out that "commons is not value laden—its outcome can be good or bad, sustainable or not" [15,p.14]. This is why there is the need to carefully consider how commons are designed, implemented and driven over time with a particular focus on fostering "understanding and clarity, skilled decision-making abilities and cooperative management strategies" [15,p.14].

2.2 Design commons: beyond robust systems toward commoning

Traditionally, the question of designing and implementing commons has focused on understanding what kind of arrangements might ensure the long-term sustainability of the shared resources and the long-term viability of collective action among participants [28,29]. Ostrom's principles for sustainable commons stress the importance of clearly defined boundaries of the shared resources; fairness in rules of provision (i.e. who contributes the most gets the most); participants' engagement in defining rules; monitoring use and sanctioning misuse; local mechanisms for resolving conflicts among participants; governmental authorities recognizing and respecting commons arrangements; and, in the case of large commons, the need for nested organizations and structures [28,29].

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[2] A makerspace is a facility where participants share tools and skills to engage in more or less collaborative explorations of different production practices.

More recently, how the viability of collective action is connected to the values and emotions of the single participants [26] has been discussed. Additionally, it has been pointed out how the creation of robust organizational systems might actually be a threat to the commons [6]. These systems tend to ossify over time, and thus, hinder possibilities of reworking arrangements when changes in the context and/or among participants might arise [6]. In parallel with these reflections, commons have been increasingly discussed not only as stable systems of rules and procedures [28] but also as ongoing processes of commoning [18]. This perspective highlights the aliveness of commons [5] and how commons are realized in the everyday interactions and negotiations among people and between people and resources [7]. With commoning, the question of designing and implementing commons pairs the development of robust mechanisms and fair rules [28] with cultural [30] aspects, subjective [26] aspects, and situated conditions [5].

2.3 Urban Commoning

Commoning has also been discussed in relation to urban commons, whose specificities make Ostrom's principles not always relevant nor applicable [17]. Unlike traditional commons, urban commons are characterized by higher diversity among participants (they might be private persons or organizations; they might belong to the private, public, third sector, academia, civil society) and among their interests [8]. Thus, it might be more difficult (if not impossible) to reach alignment and consensus among them. Hence, the need for a "partner" in [27, 2] and "enabler" of [17] urban commoning who supports negotiations and cooperation among participants with divergent interests. Differences in interests and the dynamic nature of the urban context entails that commoning evolves and changes over time; thus, particular attention needs to be given to how to create possibilities for evolutions and changes by avoiding ossifications in the arrangements [8]. Building on these insights, urban commons scholars have recently highlighted how urban commons require adaptive and iterative design approaches [17].

3 CO-DESIGN AND URBAN COMMONING

3.1 A matter of infrastructuring….

Co-design engagement with commons started by focusing on the questions, "How are processes of self-governance, management and provision designed?" and "How can the rules and practices for cooperation and use of shared resources be co-designed in fair, inclusive and sustainable ways?" [20, p. 2]. In exploring these questions, the importance of considering situated conditions emerged [22,24,33] along with the cultural dimension of commons [21,22,24]. Additionally, the need to foster participants' appropriation [40] and develop shared understandings and values among them has been highlighted [21]. Infrastructuring, in particular, has been repeatedly

proposed as a key approach [22,24,33]. The co-design approach of infrastructuring builds upon Star and Ruhleder's understanding of infrastructures as socio-material configurations embedded inside other structures and social arrangements [37]. Infrastructures shape and are shaped by the practices they support; they are normally invisible but become visible when breakdowns occur [37]. As an approach, infrastructuring is understood as an ongoing, long-term and emergent designerly effort aimed at aligning humans and non-humans (technologies, resources, spaces) for the emergence of new practices [16]. It is an effort where agency is distributed among the different participants [16]. When it comes to co-design commons, it is argued that the emergent nature of infrastructuring allows to embrace the situated conditions of commoning and to take into consideration material, subjective, and cultural aspects [22,24,33]. Additionally, the distributed agency of infrastructuring accommodates the need to foster participants' appropriation [40], as it creates opportunities for shared decision making within the design process itself [20].

Recently, it has been highlighted how, in infrastructuring for cultural commons, particular attention needs to be given to the installed base [22,24]. Star and Ruhleder [37] and Star [38] underlined how an infrastructure does not grow *de novo*, but rather "it wrestles with the inertia of the installed base and inherent strengths and limitations from that base" [38 p.382]. In the case of cultural commons, the installed base is represented by the existing technological infrastructures, practices, and cultures within cultural heritage field that influence and may oppose resistance to the development of cultural commons [22, 24].

3.2 …Over time?

Preliminarily, it seems that the ongoing, long-term emergent nature of infrastructuring could suit urban commons over time and their need to rework arrangements. Yet, these findings have been developed by experimenting and probing infrastructuring mostly in the phases of initiating commons [22,24,33]. Thus, it might be worthwhile to look in more detail at how urban commons evolve over time in order to further refine infrastructuring as an approach for urban commons. In particular, it seems relevant to consider when and how arrangements are reworked and the role of partners/enablers in such a process. Additionally, considering urban commoning over time may also provide insights regarding the relationship between urban commons, democracy, and urban governance.

4 ATTEMPTS AT URBAN COMMONING OVER TIME

This article builds on insights from two cases: a makerspace and a neighborhood upcycling center both located in the city of Malmö, Sweden. They can be considered urban commons, as

they have engaged people and organizations in collectively establishing, running and managing these two initiatives. Over time, they have experimented with different collaborative arrangements that entail different forms of co-ownership and diverse ways to perform and organize collective action.

As a co-design researcher, I had the possibility to closely follow the development of these two initiatives, as I have been working "embedded" in them; more specifically, I took part in their design, development and the running of them as an insider. This approach allowed the gathering of data about their development through active engagement, observations, and interviews with key people.

These cases have been partially discussed in previous work with a focus on the initial phases [33,35]. Here, the attention will be on commoning over time, looking at why and how they evolved and the consequences of this.

4.2 The makerspace: issues with transitory participation and plurality

The makerspace was set up in a facility owned by the municipality and driven by an NGO as a space for various cultural activities. The setting up and running of the makerspace engaged the NGO, researchers from Malmö University (and particularly myself), and various participants. The concepts of urban commons and commoning were introduced quite late in the process mainly as a way to articulate and understand what was happening in the space. However, from the beginning, there was a strong focus on engaging participants in the design and running of the makerspace. This focus was inspired by the key features of maker culture: sharing and collaboration; peer-to-peer production and learning; and participants empowerment [11,31].

In the first three years (2011–2013), the makerspace experimented with two different arrangements. The reworking of the first arrangement was due to issues with transient participation and lack of plurality in the space.

The first arrangement emerged from an initial infrastructuring effort that, through organized events, spontaneous activities, and explicit invitations, brought different participants into the space who engaged in inhabiting and developing the makerspace together with the NGO and the author. This shared effort focused on material, subjective, and cultural aspects as well as local conditions [see 33]. It led to an arrangement in which a group of core participants ran and managed the space in close collaboration with the NGO. However, after some time, this arrangement revealed a number of issues. The participation was transitory (i.e. not stable over time), and this made it difficult to ensure continuity in the management of the equipment. The core participants complained to the NGO people about this. At the

same time, this arrangement limited opportunities to promote different uses of the space. The core participants were keen to promote their interests; thus, it was difficult for new participants (and practices) to become part of the makerspace. This became a key issue for the NGO people, whose basic financing came from the cultural department, where the amount of funding depended on the number of participants and the variety of activities happening in the makerspace. These issues pushed for reworking the existing arrangement, and led to a new arrangement where the people working for the NGO assumed greater responsibility for managing the equipment and the space while facilitating the inclusion of new participants.

A preliminary idea about this new arrangement was informally discussed by the NGO people with the core participants. However, the details of the arrangement were developed (and decided) solely by the NGO people. The new arrangement was then presented at an official meeting to all the makerspace participants. Most of the core participants stated that this would be a positive change, as it would provide them with more time to engage with their own projects. Yet, a few months after the new arrangement was in place, almost all the core participants had left the space. Afterwards, the NGO people recognized how the new arrangement not only shifted the responsibility but also the ownership over the space. It resulted in core participants losing the possibility of having unlimited access to the space and of having a say over the budget and making decisions about the space. Progressively, the people working for the NGO retained increasingly more control over the space and made decisions without consulting the participants. Maintenance was ensured and plurality was promoted but at the loss of participants' control over the space. Over time, the commoning shifted from being a key feature in both the organization of the space and participants' activities to being present in solely the latter.
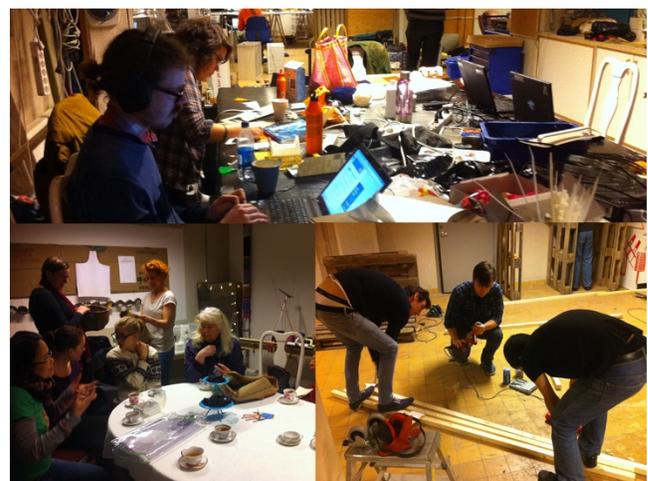

Figure 1: The makerspace

4.3 The upcycling center: issues with formal responsibilities and roles

The upcycling center is a new waste handling service with a strong focus on promoting upcycling and waste reduction. The center has three functions: It is a service for waste disposal, a free shop where people can exchange things for free, and a workshop to repair and upcycle things. The upcycling center was set up by the municipal waste department in collaboration with co-design researchers (and particularly myself) and the local makerspace. Later, it involved inhabitants and initiatives from the neighborhood, civil servants addressing socio-economic issues in the neighborhood, and the regional company working with waste processing. The concepts of urban commons and commoning were introduced from the beginning because the initial partners believed that successfully promoting waste reduction required to actively engage citizens and to create strong alliances across municipal departments and with traditional waste handling actors. This meant that much attention was focused on how to foster co-ownership of the upcycling center on a local level among inhabitants, civil servants working in the area, and other relevant organizations.

In its first two years (2015–2017), the upcycling center experimented with two different arrangements. The reworking of the first arrangement stemmed from the need to redistribute formal responsibilities and roles (including that of the partner/enabler) among the involved organizations.

The first arrangement emerged from an infrastructuring effort that explored, through events, activities and ongoing dialogue, which functions of the service could be co-owned and co-managed with the inhabitants, local civil servants and people from other relevant organizations [see 35]. The staff of the center and the civil servant responsible for it enabled commoning, which led to the first arrangement: The function of waste handling was solely controlled by the staff; the free-shop was mainly controlled by the staff in collaboration with local inhabitants and initiatives; and the workshop and related activities were developed, organized and driven in collaboration with local civil servants, inhabitants and people from other initiatives. Also, with local civil servants and staff from the library, the upcycling center staff developed shared strategies to engage kids and to deal with threatful situations. In this arrangement, commoning was very strong on an operative level, but it was poorly anchored among the managers of the waste department and the other organizations involved.

This became clear when the waste department managers decided to terminate the service without consulting the people and organizations involved because, as the managers themselves realized later on, they did not fully grasp the strong co-ownership around the service. The decision had two motivating factors.

Firstly, the waste department lacked established routines to ensure workplace safety for the staff.[3] Secondly, it turned out that, according to current policy frameworks, it was unclear to what extent the waste department could finance the workshop and its activities.

This decision led to a strong response from the local inhabitants and the other involved organizations,[4] who managed to convince the waste department managers to engage in a collaborative process to redesign the organizational model of the center and redistribute responsibilities rather than terminate the service. The process entailed articulating each organizations' responsibility and contribution to the upcycling center; to make explicit reciprocal accountability; and to design features and mechanisms for shared control and decision making.

In the new arrangement, the role of the partner/enabler is taken by the cultural department (who is already responsible for other services in the area), with a key role played by the waste department, which has the responsibility for managing waste collection at the center. Additionally, a working group and a board with representatives from all the organizations has been established. The arrangement was formalized through a cooperation agreement which is valid for one year. The agreement clearly states the centrality of local inhabitants in defining the focus for, and driving activities of, the center. However, the inhabitants have been only marginally involved in the process and lack formal representation both in the working group and on the board.

Figure 2: The upcycling center

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[3] The decision was made after a number of confrontations between the staff and some members of local gangs operating around the center premises . The upcycling center was the only staffed service that the department was directly driving at that time, and thus, they lacked routines and competences about how to manage those kind of situations.

[4] Local inhabitants protested using different channels (social media, signposts at the center, journal articles). They also collected signs that were sent to the politician overseeing the waste department. Organizations repeatedly asked the managers to review their decision.

	Initial design phase	First arrangement	Issues/Crises	Reworking phase	Second arrangement
Maker-space	Infrastructuring process that progressively engages participants in commoning and leads to the emergence of the first arrangement.	Core participants and the NGO people share control over the space. Informal organizational structure and shared decision making.	Transient participation makes ensuring maintenance hard. Core participants push for their own interests, while the NGO strives for plurality.	Initiated by a crisis. It starts with a dialogue between NGO people and participants but is later driven by the NGO people alone.	NGO takes care of maintenance and retains control over the space. Commoning is present only in the participants' own project activities.
		NGO as a partner/enabler.			NGO as a partner/enabler.
Upcycling center	Infrastructuring process that engages local inhabitants and civil servants from the area and other organizations in exploring what and how to common.	Informal sharing and collaboration with inhabitants and local civil servants about some functions of the service (free shop and workshop). Co-ownership poorly anchored among managers of the involved organizations.	Issues with ensuring workplace safety. According to policy frameworks, it is unclear if the waste department is allowed to finance the workshop and its activities.	Initiated by a major crisis. It entails the collaborative design of a new arrangement among the involved organizations but with the marginal involvement of citizens. The process ends with the formulation of a cooperation agreement that is time-limited.	Creation of a formal organizational structure with a project group and board with representatives of the different organizations. Citizens recognized as key drivers of activities and the focus of the center. Yet, citizens are neither represented in the project group or the board.
		Staff + civil servant (+ waste department) as partner/enabler.			Cultural department as partner/enabler + a key role of the waste department.

Table 1. The urban commoning process in the two cases

5 ANALYSIS

Both the cases present a similar pattern in commoning over time (see Table 1). An initial exploratory infrastructuring effort led to the emergence of a way of performing commoning that reified in an arrangement. However, over time, problems emerged with this first arrangement. These problems were related to specific local conditions of commoning (e.g., transient participation) and to external frameworks that influenced these local conditions (e.g., financing schemes and policy). In both cases, these problems led to a crisis in the way commoning was performed, and thus, the need to rework arrangements. This latter phase was a critical moment that entailed opportunities, as well as risks, for the continuation of commoning. The way this phase was driven and what it led to varied in the two cases. There are also differences in the way the partner/enabler operated over time, how democratic aspects unfolded in the commoning, and in the relationship between the two urban commons and local urban governance. The following subsections outline the similarities and differences of these issues.

5.1 Commoning phases: the challenges of reworking arrangements

It clearly emerges how reworking an arrangement is delicate and risky. In both cases, it is initiated by a major crisis in the arrangement that affects commoning, the participants' activities and, in the case of the upcycling center, jeopardizes the very existence of the urban commons.

In the two cases, the reworking phase is very different from the initial phase. It does not have an exploratory and open-ended character, but rather it becomes an effort of recombining existing resources, actors, and people in a new arrangement. It is foremost a process that aims at responding to the crises rather than further exploring ways to perform commoning. In the case of the makerspace, it even loses its collaborative nature and becomes solely the effort of the partner/enabler. In the case of the upcycling center, it is still a collaborative effort; however, official documents and formalized meetings take the place of shared activities and events. It is important to note how, in these cases, the reworking happened in an atmosphere that was quite different from that of the initial phases. The enthusiasm about collaborative experimentation became replaced by the frustration of a failure and even mistrust among the engaged people.

The new arrangements are responses to the issues that caused the crises in the first place, and they do so by finding ways to simplify and formalize practices of sharing and collaboration. In the makerspace, this entails that main responsibilities are shifted from participants to the NGO people. In the upcycling center, this entails a focus on articulating and formalizing each organization's role and commitment to commoning and also ensuring that commoning is, at the same time, anchored on the operative and decisional levels among participating organizations.

5.2 The partner/enabler: supporting or hindering urban commons?

In the two cases, the role of the partner/enabler is taken by different actors: In the makerspace, it was an NGO, and in the upcycling center, it was two different municipal departments. The nature and preconditions of these organizations are fundamentally different, but nevertheless, it is possible to recognize some shared features when it comes to their role in commoning.

Both the makerspace and the upcycling center highlight the importance of the partner/enabler in urban commons as the one initiating and supporting commoning over time and taking charge of reworking arrangements. Also, both cases underline the ambiguity of this role, as partners/enablers can shift from enabling commoning to hindering, and even terminating, it.

An important feature of this role seems to reside in the way the partner/enabler interacts with participants, and more specifically, how transparency and accountability are ensured in this relationship. The decision to terminate the upcycling center led to strong reactions among the inhabitants and representatives of the participating organizations. In particular, the latter expressed that they understood the motivations behind such decision, but they expected that the waste department managers would have reach out to them before taking such decision. The importance of transparency and accountability also emerges in the second arrangement of the makerspace, with core participants leaving the space when the NGO started to make decisions over the space without consulting them.

It also emerges how the partners/enablers' way of operating is strongly influenced by policy and organizational frameworks that shape their legitimacy and conditions for operating. In the case of the makerspace, the fact that the NGO's basic funding depends on the number of participants and diversity in the space, had a great impact on the way commoning was performed and emphasized questions of plurality. Similarly, in the upcycling center, existing policy frameworks and organizational limits hindered the waste department's possibilities to act as a partner/enabler.

5.3 Articulating democratic aspects

The different arrangements also provide insights about how democratic aspects might be embraced or neglected in urban commons. For example, in the upcycling center local inhabitants are considered key for the running and development of the center. In the second arrangement, the cooperation agreement clearly states the importance of local people, yet they are neither represented in the operative group nor on the board.

The makerspace case clearly shows a tension between arrangements based on participatory decision making and questions of plurality and inclusion. The first arrangement provided the participants with direct control over the space, yet it made the inclusion of newcomers difficult, which hindered plurality of interests and practices in the space. The

second arrangement supports inclusion and plurality but does not provide the participants with any opportunities to influence decision making.

5.4 Considerations about urban governance

The makerspace is hosted in a building owned by the municipality and partially financed by the cultural department. Through its activities, the NGO is in contact with different municipal departments. Yet, these relationships are quite loose and it is unclear if and how experiences and learnings developed in the makerspace travel within municipal structures and/or to other local initiatives. Additionally, the focus of impacting local governance has never been key for the NGO people and the participants in the space. Thus, it is difficult to trace any direct impact of the makerspace on local city governance.

At the same time, every year, the makerspace receives a consistent number of study visits from similar organizations and municipalities from within the country and abroad who are interested in learning about its experiences. In this respect, the makerspace acts as an example and provides inspiration for a different way to organize and manage cultural spaces in urban settings.

Some of the civil servants involved with the upcycling center are particularly interested in participative and inclusive forms of governance. The second arrangement seems promising in this sense, with commoning being anchored both on the operative and on managerial levels. This anchoring facilitates the spreading of experiences and learnings at different levels within the departments. Thus, there might be a greater chance to influence structures and ways of operating within these departments. For example, the waste department, at the moment, is considering how to work more systematically with citizens' involvement in the development of new services. This might open for more inclusive forms of governance in waste handling in Malmö.

However, the strong focus on anchoring commons within municipal departments and participating organizations has led to the development of an arrangement that does not provide any possibility for single individuals to engage in the managing and the decision making of the center. Thus, it can be questioned to which extent the center is actually promoting more participative and inclusive forms of governance.

6 DISCUSSION

The insights that emerge from the analysis (Table 2) can be used to further articulate the nature of urban commoning over time and how it might be possible "to infrastructure" for such process. Of course, this is just a preliminary articulation that does not pretend to provide definitive answers but rather suggests possible patterns and themes that could be explored in future research.

6.1 Urban commoning over time: exploration, reification and reworking

When it comes to urban commoning over time, it emerges as a quite lively (and sometimes turbulent) process that entails different phases. The initial phase explores practices and interactions among the people and resources involved in commoning. Through this first phase, a mode of commoning emerges which is reified in an arrangement. It is important to note that arrangements do not need to be explicit or formalized to be reified. Rather, in both cases, the initial arrangements are based on tacit knowledge and informal agreements between participants. This reflects the importance of subjective [26] and cultural [30] aspects in urban commoning. Instead, formalization appears important when dealing with anchoring urban commoning within municipal departments and participants that are organizations.

by Rodotá [32] and Ostrom and Hess [15], the cases show how urban commons are not democractic per sé, and thus, the need to carefully consider if and how democratic aspects are at play in each case.

Foster [8] discusses the ossification of arrangements as a key risk for urban commons. The cases highlight how the reworking of arrangements might be also a critical moment. In this process, it emerges the importance of ensuring transparency and accountability between the partner/enabler and the participants. There is also a clear indication of how reworking arrangements in the aftermath of a crisis is quite a challenge. By focusing too much on the problem that led to the crisis in the first place, there is the risk of overlooking the importance of other elements (like transparency and accountability). Another critical aspect is how to deal with possible tensions and mistrust among participants that might lead to difficulties in collaboratively reworking

	Reworking arrangements	Role of the partner/enabler	Democratic aspects	Considerations about urban governance
Maker-space	1. *Initiated by a crisis* in the relation to equipment maintenance and future financing (i.e., plurality as funding criteria). 2. *Neither explorative nor open-ended, it focuses on finding a concrete solution.* 3. It simplifies/reduces commoning. 4. Driven by only one actor. 5. *Discontent among core participants. NGO worried about the future of the space.*	1.*The centrality of communication with /accountability toward participants* (2nd arrangement: NGO works on its own-> participants leave) 2. The importance of NGOs financing *framework* in the city of M.	1.Tension between participatory decision making and plurality (participants control vs NGO control).	1. Governance questions are not key 2. NGO has weak connections with city departments. It is unclear how much learnings and experiences travel not only within the municipality but also to other organizations in the city. 3. Many study visits from other cities
Upcycling center	1. *Initiated by a crisis*: the threat to the existence of the center. 2. *Neither explorative nor open-ended, it focuses on finding a solution for the center to continue.* 3. Formalization and anchoring of commoning. 4. Collective design process but with a different partner/enabler. 5. *Tensions and mistrust among participants.*	1. *The centrality of communication with/accountability towards participants.* (first arrangement: the waste department takes decision on its own-> strong reaction). 2. The importance of waste policy *framework* and municipal departments organizational resources.	1. Actions may contradict intentions (second arrangement: citizens are key, yet they are neither represented in the working group nor on the board.)	1. Governance questions are key 2. Close relationship with different city departments. Introducing new ways of working within the waste department. 3. Yet, no opportunity for individuals to engage in the managing and decision making of the center.

Table 2. Summary of the key insights from the two cases. Insights which may be considered similar are italicized.

It is interesting to note how urban commoning depends not only on very specific local conditions (who and what is involved in commoning) but also on larger frameworks (like participants' organizational structures and local policy). Thus, commoning appears to be situated in very local and specific socio-material conditions, but depending on larger frameworks which may not be explicitly visible or manifested in the everyday practices and interaction of the participants. The cases exemplify how participants' and partners/enablers' resources, mandates, and ways of operating are strongly influenced by policy frameworks and organizational forms. Larger frameworks also influence if and how democratic aspects are prioritized in commoning in addition to the relationship between single urban commons and wider urban governance questions. In line with what was pointed out

arrangements.

6.2 Further articulating infrastructuring for urban commoning

Both cases clearly highlight that urban commoning requires an ongoing design effort able to address the issues and questions that emerge along the way. There are clear indications that a collective approach with distributed agency may allow the tapping in to the participants' different resources and competences. A collective approach builds on and nurtures participants' commitment to commoning. Thus, it seems that

infrastructuring may be a relevant approach for commoning over time, as it allows for the creation and nurturing of a shared commons culture [21,22,24], while at the same time, dealing with practical and organizational aspects.

The cases also highlight specific aspects that may be important to consider when infrastructuring for urban commoning. They also provide hints about possible strategies to deal with these aspects.

Temporality and fallibility of arrangements. It is quite evident that a crisis is not a favorable starting point for the reworking of arrangements. It can jeopardize trust and commitment among the participants, as they may tend to push the focus toward a single issue rather than the whole. Key questions to further investigate is if and how these crises could be prevented. As the literature and cases point out, arrangements in urban commons may need to be reworked from time to time for reasons and motivations that cannot (or might not) be foreseen in advanced. Thus, rather than wait for a crisis to hit the arrangement, it might be important to develop strategies and formats that allow to collectively identify (and discuss) possible critical issues before they become crises. A suggestion for how this could be done can be found in the second arrangement of the upcycling center. Here, in addition to specifying forms and modalities for commoning, the cooperative agreement clearly indicates that the arrangement is temporal and that, every six months, the participants should discuss if and how to rework it. Beside concrete occasions to collectively discuss possible criticalities in the arrangements, it also seems important to create and nurture a shared understanding and culture about the temporality and fallibility of arrangements.

Transparency and accountability: a collective partner/enabler?
Another important aspect seems to be how to support transparency and accountability in the relationships among participants over time, and particularly, in the relationship between participants and the partner/enabler. This appears crucial, particularly when crises hit the commons. The case of the makerspace highlights how transparency and accountability may be forgotten or taken for granted over time. It is thus important to develop possible strategies that remind the participants (and the partner/enabler) about their importance. In the second arrangement of the upcycling center, for example, regular meetings between the representative of the different organizations are seen as a way to ensure transparency and reciprocal accountability. Additionally, while the role of the partner/enabler is taken by the cultural department, the waste department still has responsibility over a key function of center (i.e. collecting and managing waste). Thus, it can be said that the role of the partner/enabler is partially shared by the two organizations, who are then in need of periodically coordinating and aligning their decisions and actions. It is too early to make any conclusions about this strategy; however, it seems that

sharing the partner/enabler's role among the participants could be a possible way to foster transparency and accountability over time.

Addressing the installed base of urban commons. Marttila [22] and Marttila Botero [24] highlight the key role of the installed base [38] in infrastructuring for cultural commons. These cases highlight the influence of frameworks on urban commoning – frameworks such as policy, participants' organizational structures, and understandings about the realm of the commoning (e.g., makers' culture and waste-handling procedures). These frameworks might be understood as installed bases, because, as discussed in 6.1, they profoundly influence (and also might hinder) commoning. They also have a key role in shaping the way democratic aspects are at play in the arrangements and the relationship between urban commons and governance structures.

These insights indicate the importance of recognizing and addressing the installed base. This entails being able to trace and understand which external frameworks and factors might influence the specific commoning process. It also entails evaluating and deciding on how to deal with the installed base. Sometimes, it might be possible to recognize its role without the need to engage with it, see, for example, how in the makerspace case, it was recognized the role of the municipal financing policy for NGOs, but no effort was dedicated to engaging with such a framework. Other times, for commoning to thrive, it is fundamental to engage with the installed base, as in the case of the upcycling center, where the need emerged to anchor commoning within the different participating organizations and thus engage with their organizational, policy and cultural framework. This entailed having to partially deal with the limits of these frameworks and partially open up for opportunities to influence them.

Separating democratic and governance aspects. Section 6.1 addresses how democratic aspects and potential impact on governance do not go hand in hand in urban commons. It also highlights how urban commons are neither intrinsically democratic in their arrangements nor transformative in relation to urban governance.

The cases highlight the importance of articulating how democratic aspects are at play (or not) in urban commons and how urban commons may impact urban governance. This entails addressing the possible democratic limits of the arrangements. For example, in the first arrangement of the makerspace, it emerges how participatory forms of decision making might hinder plurality in commoning. In the second arrangement of the upcycling center, it can be discussed to which extent control is distributed between formal organizations and local inhabitants.

It also appears important to distinguish intrinsic democratic aspects in the arrangements, with opportunities for urban commons to impact urban governance. The upcycling center presents arrangements that might present democratic limits, yet

its establishment and development have had an impact on opening for more participative governance forms in waste handling.

Thus, it appears important that the infrastructuring process clearly distinguishes and separately addresses questions related to the democratic nature of commoning as well as questions about the impact of urban commons on urban governance. Separating these questions might also help on a more general level to further articulate different forms of urban commons and when they might be suitable.

Appropiating infrastructuring approaches. The cases offer opportunities to reflect on the possible role of the co-designer in prolonged infrastructuring efforts. In both cases, it clearly emerges how the co-designer is not the main driver of commoning. She is part of it and contributes to it, but it is mainly the partner/producer who enables and supports the process over time. Consequently, the partner/enabler will play also a key role in initiating, informing and sustaining infrastructuring over time. Thus, the importance of a close engagement between the co-designer and the partner/enabler. An engagement that should aim toward creating the conditions for a long-term infrastructuring effort. This would entail introducing infrastructuring approaches and support their appropriation among participants, particularly among partners/enablers. In the case of the upcycling center, my presence as an "embedded designer" facilitated ongoing articulation and the appropriation of co-design approaches among the people responsible for the upcycling center. This is described in more detail in [35], but it basically entailed my close engagement in the development and running of the center. This was accomplished by being part of and supporting initial ideation phases, by taking initiative in reaching out to different actors and inhabitants in the area, and by co-organizing activities and events. In addition, this was paired with an effort aimed at supporting ongoing reflection and evaluation about the process with the staff of the center and the civil servant responsible for it. This allowed for the continuous readjusting of infrastructuring activities to develop a shared understanding of what infrastructuring is and to support the appropriation of approaches and concepts by the staff and the civil servant responsible for the center.

The focus was not only on supporting experimentation and the use of iterative approaches but also on fostering the participants' reflection and learning along the way. This calls for the long-term engagement of co-designers with urban commons not only in the initial phases but also in sustaining them over time.

6 CONCLUSIONS

The article aims at contributing to the further understanding of the nature of urban commons and how co-design approaches, and infrastructuring in particular, might support urban commoning over time.

It gives an overview of commons theory, according to which urban commons are collaborative arrangements for the creation, use, and management of different possible resources in an urban context. Urban commons are characterized by ongoing processes of commoning that bring together participants with different interests. Such diversity entails that arrangements might need to be reworked over time. Additionally, urban commons are also characterized by the presence of a partner/enabler that initiates and supports urban commoning over time. The article also reviews participatory design research on this topic and how infrastructuring is recurrently proposed as an approach in initiating commons. However, it has not been yet explored how infrastructuring might support urban commoning over time.

By looking at the development of two urban commons (a makerspace and an upcycling center, a new service for waste handling) over a couple years, the article tentatively articulates an understanding of urban commoning over time. It emerges as a process where an initial exploratory phase leads to the reification of a specific arrangement that may need to be reworked over time. This is recognized as a critical moment, as it can jeopardize the existence of the commons itself. Furthermore, the cases highlight the importance of transparency and accountability among participants in commoning. They also point to how democractic aspects might be both enhanced and neglected in urban commons and how there may be different ways in which urban commons might impact urban governance. In a nutshell, they underline how urban commons are neither intrinsically democratic nor necessarily entail more participative and inclusive forms of urban governance.

The insights from the cases are used to propose certain aspects that may be relevant in prolonged infrastructuring for urban commoning: (1) the importance of fostering an understanding of the temporal and fallible nature of arrangements in order to prevent the emergence of crises when they might need to be reworked; (2) the centrality of accountability and transparency among the participants and about the partner/enabler's decisions and actions; (3) the need to recognize and find ways to address the installed base, as in, external frameworks and factors that might influence commoning and the possibilities for urban commons to impact governance; (4) the importance of articulating democratic aspects in urban commons, and, in particular, of separating questions about the nature of arrangements and the possible impact of urban commons on local governance. These aspects suggest that the co-designer engaged in infrastructuring for urban commons needs to focus on both supporting the actual infrastructuring process and fostering the appropriation of co-design approaches among participants and the partner/enabler in order for the infrastructuring processes to continue over time.

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