

PROTOTYPES AS AGENTS OF TRANSITION: THE CASE OF DIY WIRELESS
TECHNOLOGY FOR ADVANCING COMMUNITY DIGITAL SOVEREIGNTY

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This paper explores the role of Do-It-Yourself (DIY) and open-source prototyping processes in participatory design practices aimed at advancing grassroots digital sovereignty. The emergent term “digital sovereignty” describes various forms of autonomy, self-determination and independence in relation to technologies, digital infrastructures and data. The case study we analyze here, (the MAZI EU-funded project) was planned for translating “big” questions on the meaning of digital sovereignty into situated hands-on engagements and transdisciplinary work between local residents, activists, academics and designers. It concerns a collaborative prototyping process that focuses on the development of Community Wireless Network (CWN) technology in Berlin’s urban space, for creating locally and corporate-free platforms for sharing information and organizing collective action. The paper shows how DIY and open source prototyping can positively contribute to addressing challenges of participation towards digital sovereignty in the city, by bringing together different political and epistemic groups in academy-community partnership. However, by critically examining the tensions and conflicts that emerged in the process, it argues that openness and collaborative experimentation in itself do not guarantee the long-term infrastructuring goals of digital participation, self-determination and autonomy. Rather, the broader transition to digital sovereignty requires long-term design coalitions for sustaining the ongoing maintenance of open and collaborative socio-technical infrastructures.

Keywords: Transition, Prototyping, Self-determination, Digital sovereignty, Community Wireless Networks, DIY-Networking, Academy-Community partnerships, open-source technology, right to the city

Complement: [Collective learning \[pdf\]](#)

1. INTRODUCTION

This paper explores the role of Do-It-Yourself (DIY) and open-source prototyping processes as participatory design practices for advancing grassroots digital sovereignty. The emergent term “digital sovereignty” describes various forms of autonomy, self-determination and independence in relation to technologies, digital infrastructures and data. It has percolated in academic and policy debates to address the rapid encroachment of corporate big data technologies playing a central role in shaping social and political life. As information and communication technologies (ICT) are strongly commercialized and centralized by a

few technology corporations, civil society is often stripped of individual and collective rights as well as political agency in regard to ownership and control over the production and use of data and digital infrastructures. These rapid developments toward an extractive “corporate sovereignty” (Floridi, 2020) over urban, environmental and informational resources raise many urgent questions on what we mean by “democracy” in a technologically, machine-driven age. After all, the power of corporations lies not only in developing and controlling the back-end design of data infrastructures. While serving a particular logic of capitalist accumulation, the highly specialized corporate capacities to aggregate and analyze massive amounts of data allow the datafication and monetization of every possible aspect of everyday life (Boyd & Crawford, 2012; Mayer-Schönberger & Cukier, 2013; Zuboff, 2015).

While territorial and nation-based perspectives on digital sovereignty are prevalent,[1] the understanding of digital sovereignty as digital self-determination and autonomy through collective control is increasingly articulated by civil society entities and global social movements.[2] Closely connected to social justice narratives, such concepts of digital sovereignty often stipulate a needed transition toward social control over technologies and digital infrastructures; emphasize the development and use of digital tools that are conceived within community ecosystems; and aim at raising community awareness, fostering digital participation and the re-appropriation of technologies (Couture, 2017; Haché, 2014).

Drawing on these articulations of community-driven digital sovereignty, we examine the role of participatory design and open-source prototyping in advancing these transitional futures. Our case study analysis concerns a collaborative prototyping process of an open-source community wireless technology in Berlin's urban space, for creating locally and independently controlled platforms for sharing information and organizing collective action (hereafter, "MAZI Berlin"). The MAZI (meaning together in Greek) project was a three-year EU-funded research project aimed at creating socio-technical infrastructures for establishing community-based digital sovereignty, with pilot cases in three major cities – Berlin, Zurich, London – and in several towns in rural Greece.[3] Studies of socio-technical transition research (Geels, 2019; Moser, 2016) have shown that participatory design can act as agent of transformation; however, advancing transformational processes requires a reflexive, critical and nuanced examination of collaborative processes. While participatory and co-design process are grounded in experience, their outputs are often "guidelines" or "tutorials" that give little insight into the actual hands-on experiences of implementing collaborative design work (Moser, 2016). Nevertheless, studies of transformation toward sustainability show that collaborative or transdisciplinary socio-technical processes tend to

bring to the surface power dynamics, contested questions of ownership, epistemic and value differences while demonstrating the role of conflict as an agent of transformation (Geels, 2019; Moser, 2016; Parsons, Fisher, & Nalau, 2016; Temper & Del Bene, 2016). The participatory prototyping process we analyze here, was planned for translating "big" questions on the meaning of digital sovereignty into hands-on engagement and transdisciplinary work which inevitably gave rise to epistemic and value-based conflicts and tensions. We take the opportunity here to consciously and critically dive into these socio-technical conflicts while examining how collaborative prototyping can play a role as an agent of transition toward grassroots digital sovereignty.

Our focus on collaborative prototyping draws on a growing body of literature in sociology, anthropology, design research and science and technology studies (STS) that expands the notion of prototyping beyond simply a technical process for the development and design of technological objects [4] (Corsín Jiménez, 2014; Guggenheim, 2014; Christopher M. Kelty, 2010; Lezaun & Calvillo, 2014; Marcus, 2014; Suchman, 2000). Research in these fields delves into the social and political role of prototyping, or technology-in-the-making, for developing material forms of participation and democratic practices. As Suchman et al. (2002) show, interdisciplinary reconstructions of prototypes allow for the development of innovative processes that transform the focus on invention as a singular event to its reconstruction as diverse collaborations across different social environments. Such analyses gained particular momentum in the past decade with the proliferation of information technologies and digital networks. In particular, open-source technologies as well as the re-emergence of DIY and hacking practices seem to radicalize the proclaimed democratization of technology. As many have shown, open, collaborative and generative processes of prototyping can serve as sites of knowledge co-production and knowledge commons (Benkler, 2006; C.M. Kelty, 2008; Powell, 2012). But at the same time, they may obscure conflicts and

perpetuate socio-economic power structures (Lanier, 2006; Tkacz, 2015; Turner, 2010).

MAZI Berlin is one example of a range of projects that seek to advance democratic and bottom-up approaches to prototyping technology.^[5] In the coming together of design and open-source culture, collaborative forms of prototyping turn both the prototype and the design process into a continuous state of “perpetual beta” (Unteidig, Calderón Lüning, & Dominguez-Cobrerros, 2017). This is where experimental or unstable versions of the design are released for use and at the same time continue to be in processes of development and documentation, maintained by the community of users/contributors. This circular movement of open-source socio-technical development has been analyzed by Christopher Kelty as the “unprecedented forms of publicity and political action” of free software and other similar and related projects that emerge from it (2008, p. 4). Kelty’s articulation of the politics of open-source cultures is particularly relevant for imagining community-driven digital sovereignty. It brings forth the idea of Free Software as a “recursive public” that is concerned with its legitimacy and independence from state-based forms of power and control, as much as corporate, commercial and non-governmental power (C.M. Kelty, 2008).

Open-source publics, to follow Kelty (2008), emerge and are sustained through the radical technological modifiability of their own terms of existence which are premised upon the internet as a singular socio-technical infrastructure. This links with an already established interest within the fields of STS and participatory design in the emergence of publics through material issues, devices, and infrastructures (Dantec & DiSalvo, 2013; Latour & Weibel, 2005; Marres, 2012). Le Dantec and DiSalvo (2013) explore the role of participatory design discourse in the formation of publics and issues and note that it is the embrace of conflict and contention in issue formation that reshapes a shift from addressing stakeholders to constituting publics. Relatedly, material participation and the constitution of publics

through and around issues suggests a broader understanding of the design as a process of “infrastructuring” which withdraws from the nexus of problem solving (Binder et al., 2011; Björgvinsson, Ehn, & Hillgren, 2010; Ehn, 2008; Ehn & Badham, 2002). However, as Le Dantec and DiSalvo (2013) show, participatory design around the constitution of publics, can both open up questions and possibilities for infrastructuring long term future-use, and narrow possibilities for designing a practical or useful system for proximate applications.

Our analysis of MAZI Berlin draws on this body of research in STS and participatory design. It concerns the political potentials of radical alternatives such as open source and collaborative prototyping for addressing broader questions on the issue of corporate sovereignty in urban and informational spheres. We connect with research in HCI in discussing the challenges of “design as infrastructuring” oriented toward building a transition to self-organized community informatics and digital sovereignty.^[6] In that regard, experiments with and infrastructures for community wireless network technologies are not new. However, MAZI’s focus on digital sovereignty diverges and contributes in other ways. The majority of community wireless network technologies are focused on providing low-cost access to broadband for community empowerment and addressing digital divides (Forlano, Powell, Shaffer, & Lennett., 2011) – in fact, one of the most established non-commercial initiatives for free wireless networks worldwide, Freifunk, is based in Berlin. Conversely, MAZI Berlin offered a collaborative development of a DIY *offline* wireless network for local file sharing and communication that would be used within hyper-local settings, at the scale of neighborhoods and by a network of various urban initiatives.

DIY engagement in CWN is a relatively new idea for introducing the political potentials of decentralized/local ownership and management of technology and data (Antoniadis, 2016). A core element of the project was based on engaging

residents in the conceptual and hands-on DIY process of planning and building the tool and through this instigating an imagination of future community informatics for digital sovereignty. This experimental orientation meant that, first, the participatory design process was aiming for instigating not only a tool but experimenting with a certain technological future; second, the project was oriented toward activists that were already mobilized and engaged with resisting and reshaping urban futures; third, that technical and design decisions in developing the hardware and software were kept open, allowing for a meaningful collaborative process that links social and technical issues. It aimed at creating transdisciplinary spaces for collaborative learning and questioning, addressing the underlying social and political assumptions that structure informational as well as urban spaces. Bringing these elements together, it sought to explore what the notion of community-driven digital sovereignty might actually mean in practice.

Methodologically, this research draws on participatory design in the intersection with action research. Two of the co-authors led the academy-community partnership in the framework of the MAZI pilot case in Berlin from their respective positions at the Design Research Lab at UdK[7] and the NGO Common Grounds[8]. Therefore, with this close and engaged positionality in regard to the research project we take the opportunity to critically reflect on the process of building community-based DIY networking in the city and discuss the conflicts and tensions that are inherent to messy processes of open-ended collaborative design projects (Temper & Del Bene, 2016).

We argue that if open and collaborative design processes are aimed at infrastructuring a future transition to community-led digital sovereignty, they must be premised on a continuous reflexive questioning as a methodology of collective listening and learning. What may be the *inadvertent* consequences of challenging the rigid boundaries of expertise through open-source tools? How can we

rework the tensions that arise when experimental, socio-technical visions are met with “old” politics, and entrenched social, political, economic perceptions, divides and inequalities? Who is accountable for the upshots of failure beyond the experimental and visionary realms of prototyping; how is failure mitigated within the realities of social context and locally situated interventions?[9]

With these core questions in mind, the discussion will flesh out the conflicts and tensions that emerged within this ambitious process and unpack some of these challenges into three categories of critique and action. First, we consciously detail the structural power dynamics in the case of MAZI Berlin as they emerged within the different phases of the project; second, we discuss frictions that became evident between the experimental realms of prototyping and the established epistemic norms and differences that shaped certain attitudes toward technology and relations between the different actors; and finally, we look into design as infrastructuring to think through and rework the troubles and limitations caused by the structures and logics of a centrally-funded and time-limited project. In what follows we begin with a brief textual and visual description of MAZI Berlin based on its three phases of implementation.

2. MAZI: COMMUNITY WIRELESS NETWORK TECHNOLOGY IN BERLIN’S URBAN SPACE

CWN technology evolved alongside wireless networks and it demonstrates a rich history of applications on various scales. Such tools are in most cases oriented toward transforming the uniform modes of digital interactions across multi-scales, which emerge as a result of the steady corporate and governmental closure of digital ecosystems. There are many examples, ranging from Dead Drops by Aram Bartholl who simply plastered USB sticks into cracks in public spaces, creating very local networks;[10] the Pirate Box, which allowed NYU students within the lecture hall to share files without breaching copyrights policies;[11] to collectively owned and managed

wireless infrastructures, such as, Freifunk in Berlin,[12] the Athens Wireless Metropolitan Network,[13] Sarantaporo community wireless network[14] in rural Greece (Antoniadis, 2016) and Guifi.net in Catalonia, Spain, which has more than 37,000 working nodes.[15] It has become relatively easy to develop a personal network, since the necessary hardware is affordable and the software has been made available through massive documentation of open-source communities of practitioners. Still, there are many socio-economical and material barriers to those who are not technologically savvy, or don't have the time and resources that technological participation requires (Haklay, 2013; Rumbul, 2015).

A guiding principle was to address the problem of alienation and access by designing a toolkit that provides low-barriers for participation by using affordable off-the-shelf technologies and shaping an inclusive terminology and discourse around the design of the prototype. The initial iteration of the toolkit has been designed using open-source components including Raspberry Pi[16] and SD cards (see Figure 1). The software was developed in part by the project partners while integrating existing Free/Libre/Open-Source Software (FLOSS)[17] to create a “plug and play” installation allowing for an easy-to-use local digital network with some pre-set applications (front-end depicted in Figure 2).

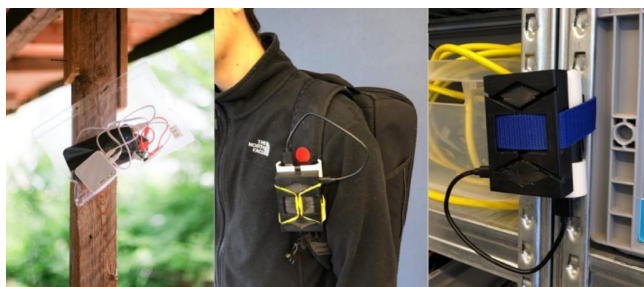


Figure 1. The technical artifact is made up of a RaspberryPi, an SD card and battery. Different casings and ways of attaching it to places have been experimented with throughout the various use cases. The solutions depicted here highlight the versatility and portability of the

toolkit. Design Research Lab.

These technical elements were accompanied by documentation of use cases and experiences as well as other physical materials such as posters, guidelines and storytelling pamphlets. All these elements, in sum, contributed to the “MAZI toolkit” (see figure 3)

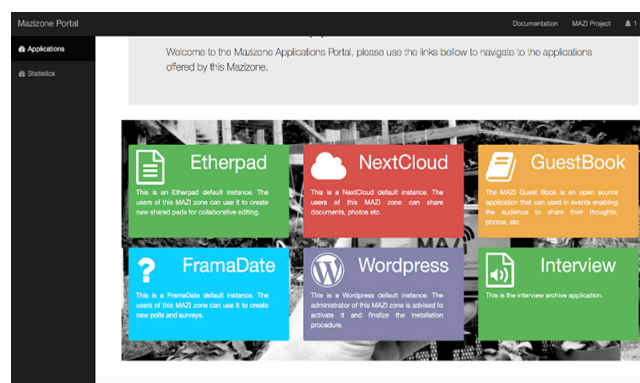


Figure 2. The default front-end seen by users of the toolkit after installation. MAZI project.

The process of conceptualizing, designing and developing these elements took shape in various academy-community partnerships, and also emerged from dialogues between the pilot groups in Zurich, London, rural Greece, and Berlin. The MAZI Berlin pilot was led by the Design Research Lab in Berlin University of the Arts (UdK) with the participation of local urban-activist initiatives, and was facilitated by the NGO Common Grounds and its educational platform “Nachbarschaftsakademie” (Neighbourhood Academy).[18] The main objective of the Berlin pilot was to advance discourses and practices around the idea of digital sovereignty with a strong focus on the urban: to address the individual and collective freedom and right to actively partake in the shaping of digital realities; to interpret, define and become involved in the construction of discourses and imaginations about community-driven, digitally mediated futures and, particularly, to look beyond commodified narratives of the smart city.



Figure 3. The toolkit also included informational materials such as posters, handbooks and storytelling pamphlets. MAZI Berlin.

The main element of the MAZI project, the toolkit, brought together different groups who were interested in the possibilities of CWN tech; however, it was the main locale chosen for MAZI Berlin, Prinzessinnengarten, that played a significant role in bringing together a diverse group of people. Prinzessinnengarten is an urban community garden in Kreuzberg that envisions and develops a collaborative and protected space for learning ecology, conviviality and self-organization. It is also the Neighbourhood Academy's space of activity, a learning and knowledge exchange platform.[19] The participants in MAZI Berlin included activists, artists, researchers, designers, engineers, social workers and local community members, all involved in one way or another with the Neighbourhood Academy[20] and actively engaged in issues related to urban ecology and "the right to the city" in Berlin.[21] With this social and spatial infrastructure as a starting point, the prototyping process was designed and implemented in three phases: first, community outreach and finding common ground for collaboration;[22] second, igniting the collaborative development of the CWN technology and adapting it to local context;[23] third, deploying the technology with partners in different settings.[24]

Phase 1 – Creating common grounds for

collaborative technological development

The first phase of the MAZI Berlin pilot project aimed at situating and connecting the topic of CWN within the discursive realm of the participants. Two workshops were planned and held introducing the MAZI project and DIY networking technology. The first workshop centered around the idea of "collective learning," a concept introduced by the Neighbourhood Academy to understand urban activism as a form of emancipatory learning. It sought to identify shared interests and to discuss the relations between technological engagement and activism in the city, grow trust, social ties and to share different perspectives on what DIY networking is all about (Figure 4). The shared interest in urban ecology and the broader urban issues that mobilized the different groups that participated created a basic level of trust and a backbone for collaborative and experimental work. Urban topics such as land grabbing and new contested urban governance models for city planning echoed with discussions and issues within critical technology discourses that stand against the anti-democratic dynamics of privatization and financialization.[25] The second workshop shifted to discussions on the technological aspects of the project by collectively brainstorming ideas about DIY networks and their potentials for digital self-determination.



Figure 4. The first community workshop introduced the idea of MAZI to a range of different stakeholders. MAZI Berlin.

Phase 2 – Collaborative development of CWN technology

As part of the second workshop, initial technological

ideas were formulated around the needs, wishes and desires related to matters of concern brought to the table by participants. With the help of quick and loosely structured prototypes (storyboarding, paper prototypes, click dummies, etc. see Figure 5). In this context the idea of “MAZI Zones” was appropriated as participants developed potential use cases for multiple adaptations of the toolkit within different settings in Berlin. The group discussed how each MAZI Zone should be contextualized, deployed and governed by the various initiatives, with technical and design assistance by the MAZI Berlin pilot team. Subsequently, the physical presence of the Neighbourhood Academy at Prinzessinnengarten was envisioned as the central hub and platform, on which experiences and learnings from the different MAZI Zones in the wider urban landscape of Berlin were to be collected and synthesized. Toward these ends, the “MAZI Archive” software was developed by the Berlin lead pilot team with the goal to locally collect and disseminate user-generated content within the MAZI Zone. Therefore, the particular MAZI Zone at Prinzessinnengarten acted both as a local hub and as an access point for visitors and users to get to know the project more broadly. It brought together issues and experiences from other hubs, and offered more general opportunities to learn about CWN technology, the people, and activities behind it (see Figure 6).^[26]

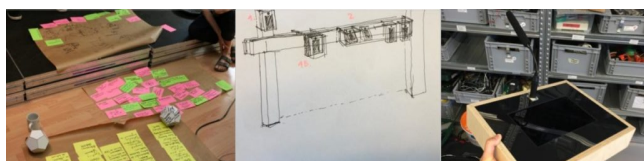


Figure 5. A large number of prototypes, sketches and discussion prompts helped facilitate the participatory process throughout the project. MAZI Berlin.

Phase 3 – Deploying the MAZI-Toolkit in multiple local settings

Aiming for openness and local versioning of the toolkit to make it versatile for a growing community of users, MAZI Zones were put into use in different settings around Berlin. By the end of the project, the

toolkit was deployed in thirteen different locales with the direct support of the lead pilot-team.^[27] It was used as research tools for seminars by academics in university settings,^[28] for communication and management in neighborhood issues by a few communities in Berlin,^[29] for self-organizing in protest related events,^[30] as an interface between researchers and visitors in the Berlin Natural History Museum (Rössig, Moormann, Faber, & Herlo, 2018), for artistic installations at the Venice Architectural Biennale 2017^[31] and for exploring the interdependence of digital tools and social innovation by the German Federal Ministry of Environmental Protection (Figure 7).



Figure 6. Installation of a permanent MAZI Zone in the Prinzessinnengarten (left). Visitors interacting with the MAZI archive sound installation (right). MAZI Berlin.



Figure 7. MAZI Zones have been used in other context, e.g. for installations at the Berlin Museum für Naturkunde (left) or the Venice Architectural Biennale 2016 (right). Design Research Lab.

The wide range of settings in which MAZI Zones were implemented required a continuous process of development and production of supplemental documentation and tutorials that would fit various contexts, stakeholders and objectives. Most deployments started with a specific workshop

format developed within the MAZI project called “unboxing,” where the toolkit was unpacked in order to let the participants get to know its components. Participants were introduced to the MAZI project, followed by a demonstration of a pre-installed MAZI Zone and a guided process in which each person assembled and configured their own personal MAZI Zone (Figure 8). Through hands-on engagements participants could see, touch and interact with the different components of DIY wireless network technology and develop a deeper understanding of both the components of the technology and the project’s critical and experimental approach.



Figure 8. In “unboxing” workshops, participants were guided through the process of assembling and installing their own MAZI Zones. MAZI Berlin.

3. DISCUSSION

3.1 Unpacking conflicts and tensions in prototyping DIY networking

The core motivation for the MAZI project centers around the right for digital self-determination and collective control over technologies and data. Yet, it shared similar logic with urban discourses and practices of the “right-to-the-city” that raise demands for democratic participation in the production of urban space. With this in mind, the experimental aspects of collaboratively prototyping CWN technology engaged participants in a process of cross-seeding, where, on the one hand, the design was influenced by the constitution of publics around and through urban issues. On the other hand, it connected between radical alternatives

(Vlachokyriakos, Crivellaro, Wright, & Olivier, 2018) by extending and solidifying the work of public housing and anti-eviction movements with work towards justice and equity in regard to the city’s technologically mediated futures. As Vlachokyriakos et al. show, such connections raise difficulties in the creation of “design coalitions”... outside the narrow boundaries of research projects and timeframes” (2018, p.9). Therefore, the emphasis within the design collaboration was on the productive as well as the processual aspects of experimentation in bridging differences, conflicts and tensions. As we show below, the participatory design process crucially turned into a problem of infrastructuring that required long term strategies along with short terms tactics (Lyle, 2018; Vlachokyriakos, 2018). In that regard, the open-source culture of development, maintenance, documentation and peer-to-peer systems that premise many previously existing CWN projects, offered a significant infrastructure for the collaborative prototyping and future use of MAZI’s community wireless network technology.

In his writing on “open source urbanism”, Alberto Corsín Jiménez (2014) remarks that prototyping incorporates failure as a legitimate result in the realization of the process and stands for reconfiguring, at once, material objects and social relations. It is a process of trial and error, he writes, and embracing failure can allow inventive practices, new experiences and processes of democratization to emerge. While we draw on these articulations of urban prototyping, it is important to acknowledge and be aware of their limitations. In what follows we discuss the conflicts and tensions that emerged within the participatory design process to formulate a politically conscious and reflexive learning that connects the openness of a collaborative prototyping process with a conscious and accountable praxis of design and critical infrastructuring (Irani & Silberman, 2014; Lyle, Sciannamblo, & Teli, 2018; Vlachokyriakos et al., 2018).

3.2 Reworking structural power dynamics in academy-community partnership

Comparing and synthesizing the discourse around urban and technological rights over infrastructures created a space in which a diverse range of already-mobilized group of people could collaborate and engage in processes of mutual knowledge production – but it was only the first step. Academy-community partnerships are burdened with tensions. Inevitably, there are potential contradictions between the realms of the research project and the expectations, responses and concrete needs brought by participants. During the MAZI Berlin project there were demands placed on the various urban initiatives that took part to invest their time, skills and knowledges in the project. This required clarity with regard to the concrete benefits participants would gain from taking part in the project.

Over the years, the Neighborhood Academy played the role of a gatekeeper and facilitator for building productive collaborations and relationships with urban initiatives within various settings. In participatory research and design projects, the community gatekeepers play an important role, as they hold the power to allow or deny access to particular communities or institutions (Lenette et al., 2019). In the MAZI project, these roles were part of the negotiation between the UdK and the Neighborhood Academy from the very early stages.

A level of reservation toward this collaboration was evident when participants addressed the phenomenon of ‘academic harvesting’, i.e., the one-sided withdrawal of knowledge by researchers. This raised the need for a careful consideration of under-valued and “invisible” forms of labor (D’Ignazio & Klein, 2016) within the different phases of the project. For example, one of the activists in the Neighborhood Academy mentioned the considerable and burdensome workload he experienced over the years, due to the fact that the community garden has become a popular subject of countless Bachelor, Master and Doctoral theses. While the activists

welcomed such collaborations (and the visibility they generate), they often experienced a lack of concrete exchange value and, in many cases, research findings and outcomes were not shared back.

Hence, a considerable level of trust had to be established within the lead pilot-team (UdK and Common Grounds) before it could even advance to engaging activists from different urban initiatives. This initial robustness in reflecting roles and expectations, helped set a standard of reciprocity for the rest of the project. It enabled to critically rework power relations and specifically address the need for a two-way relationship to make sure that the outcomes of joint efforts are also equally distributed (D’Ignazio & Klein, 2016).

One of the tactics developed in order to establish trust and fairness within the process was to financially compensate the initiatives participating in MAZI Berlin for sharing their expertise and insights in workshops and other events. This was decided in a transparent discussion on the financial structure and available funds within the project’s budget. Furthermore, the reciprocal sharing of skills and knowledges during workshops related to CWN technology constituted another aspect for creating mutually beneficial relationships of collaboration and exchange. The workshops provided the base for collectively prototyping parts of the MAZI toolkit, but, moreover, they created a shared space for different initiatives to address and share resources, challenges and needs. Furthermore, the actual deployments of MAZI Zones (project’s third phase) allowed the establishment of shared ownership and use of hardware and software, while providing technological support for the initiatives in their independent projects.

3.3 Between experimental realms and epistemic norms

While all these arrangements and agreements sound like solutions, tensions that stood in the way were entangled in more complex sets of epistemic

norms and expectations that many times pose significant challenges in collaborative, civic and open source projects (Rey-Mazón, Keysar, Dosemagen, D'Ignazio, & Blair, 2018). For CWN to become a tool for instigating self-organized digital sovereignty, a prerequisite is a community-based awareness and capacity to exercise control over the development and implementation of digital technologies. Critical awareness to the patterns of corporate sovereignty over technologies and data was discussed and built among participants, creating strong discursive connections between the technical components of the prototype and its social, political and economic implications (Lyle et al., 2018).

Within processes of experimentation, the decision of whether a prototype should be high or low fidelity, paper sketch or material object, “messy” or “quick and dirty,” does not merely relate to questions of flexibility, cost and time, but also shapes a politics to the process. It determines who can (or feels entitled to) participate in the process, what role can one play and how meaningful can one’s contribution be. Therefore, taking “messiness” seriously means openly engaging with issues of ownership, authorship and control in the realms of technological development, and taking an active role in shaping its politics.[32] The disciplinary and epistemological backgrounds introduced by the heterogeneous actors – activists, designers, researchers, neighbors – diverged widely and required mediation. While the design researchers had a strong interest in experimental work that tests different “half-baked” prototypes and cultivates openness, activists expected a certain degree of “doneness.” Many times, urban political activists have little time to “stray” or “tinker” around for the purpose of exploration, as they tend to work under relatively precarious conditions toward goals that are difficult to achieve. In this regard, an exploratory, open design process with a high degree of ambiguity may very well result in antagonism and counter-productive results.

The project depended on overcoming this basic

alienation toward experimental, “half baked” technology, which requires significant investment before it fully performs its tasks. While it sought to address the need for concrete and viable alternative technological solutions that would allow to challenge power dynamics between users/activists, developers, administrators and owners (Antoniadis & Apostol, 2014), the main impediment was in challenging the boundaries and normative expectation toward expert solutions. The pilot team had to continuously address and deconstruct roles ascribed to them, such as being perceived as “service providers” that deliver solutions in the form of reliable technologies to passive customer-users.

The tensions between users and experts were dealt with by purposefully keeping open several design decisions regarding the MAZI toolkit. Issues and questions that arose were negotiated in situ through ongoing practices of design-in-use. Such questions included: what are the components of the toolkit? for which contexts and for which purposes can it be used? by whom? How will the system be managed and maintained? While the process of identifying the problem space was meant to be “messy” by leaving much of the design process unstructured and relying on the active collaboration of participants, it also meant that participants and facilitators would directly engage with the underlying infrastructures of CWN technology and develop critical thinking on the structure of technology itself.

3.4 Infrastructuring against the troubles of project logics

This tension between “openness” and solutions, outputs or “deliverables” came across in the inherent conflict between the realms of continuous and often strenuous processes of community activism and the logics of project-based interventions. By “project logics”, we refer to the often rigid structure in which work is organized and managed in research and development projects, often adhering to (if not mirroring) the hierarchies and result-based expectations of academic

institutions and funding organizations (Torka, 2009). Academic and funding bodies demand the process to be structured by clear beginning and end dates, as well as agreed-upon deliverables and, usually, a certain degree of positivistic pressure (as in delivering a solution to a previously described problem). These pressures had to be continuously re-negotiated within the “messy” processes of an open and collaborative prototyping process. Consequently, the project’s partners had to identify and negotiate ways to deliver an outcome that would adhere to institutional requirements, and at the same time ensure that MAZI Berlin will have a lasting and meaningful effect.

To follow the aspirations of open-source culture, it had to grow a community that would continue to use and maintain tools and techniques for CWN technology beyond the official end of the funded project, which in turn, would motivate the constitution of public around digital sovereignty. However, problems of maintenance, adoption and sustainability, as Irani and Silberman (2014) write, stretch beyond the conventional role of a designer, and require a less glamorous and more labor-intensive work. This was addressed by the lead pilot-team halfway through the project’s phases who decided to shift away from a focus on project “outcomes” to thinking and developing a socio-technical infrastructure that would offer an affordable and well-documented open design that can be easily reused and reappropriated.

Infrastructuring in that regard included design choices on the hardware and software level that were oriented toward adaptability and ease of use; documentation and knowledge repositories extended well beyond technical issues in order to include storytelling of exemplary use cases of MAZI Zones and lessons learned (MAZI project, 2018). Furthermore, a strong emphasis was given on technical training and the careful establishment of a “community-of-practice” (Wenger, 1998) that would make it possible and probable that future projects will continue growing from the infrastructure established by MAZI Berlin.

Having said that, long-lasting usability and necessary maintenance of DIY technologies remain a problem within the context of academic research projects, and for community wireless network technology specifically (Byrum, 2015). While the MAZI Berlin lead pilot team focused on certain aspects of the design and its long-lasting effect, the project’s structure and logic couldn’t possibly provide for upward compatibility through maintenance and upgrades. Continuously updating the toolkit to adapt with external hardware upgrades is an uphill battle for a small academic team. As a result, the software providing the base for the MAZI toolkit is not supported by current versions of the Raspberry Pi, and it is becoming increasingly difficult to acquire older versions of the microcontroller in order to use the toolkit. With no remaining funds, and the academic and technical team moving on to other endeavors, sustainability and maintenance proves very difficult. Any upgrade would merely be a temporary step towards the same problem repeating itself with the next major version update of the technology in use. However, the relative simplicity of the MAZI toolkit proved fruitful, as some of the workshop participants found their own ways of acquiring funding and continued the use and development of MAZI.[33] On top of that, new projects in entirely different contexts have been initiated building on the toolkit and its accompanying repositories.[34]

4. CONCLUSION

Irani and Silberman succinctly write that “the futures of repair [should] constitute our imagination of what we want to design” (2014, 35). We should shift the dominant emphasis from innovation to repair which “lies somewhere else: lower, later or after innovation in process and worth” (Jackson S.J., 2014 quoted in Irani & Silberman, 2014, 35). Such insights are invaluable for learning openness together with accountability. Through our case study analysis we discussed how DIY and open source prototyping can contribute to addressing challenges of participatory processes in academy-community

settings. Experimental processes might be indispensable for prototyping futures of community informatics and digital sovereignty, yet openness and collaborative experimentation in itself do not guarantee the long-term infrastructuring goals of digital participation, self-determination and autonomy.

Participatory design and open, DIY technologies can play an important role in advancing transitional futures toward socio-technical infrastructures and social solidarities. Common tendencies toward hackathons and quick prototypes, as Irani and Silberman show, “risk devaluing the slow work of creating critical infrastructures” (2018, p32). In MAZI Berlin, the curated, but nonetheless experimental phases with the self-built toolkit over a period of three years required the pilot-team and participants to embrace difference and tensions as resources, rather than obstacles, for design, discourse and co-production of knowledge. It opened opportunities for growing a shared sense of authorship and ownership in regard to network technology. In that respect, roles, mandates and power structures had to be addressed and collectively approached as contingent objects that can be navigated, altered and adapted (Freeman, 1972). Having said that, the question of sustainability within academic and centrally funded projects, such as MAZI, remains.

The MAZI Berlin experience shows the challenges of maintaining ongoing compatibility of a technical system. But at the same time, it demonstrates the necessity to deeply reconfigure the role of design and designers as important agents for the constitution of publics and collectivities by insisting on the inseparable generative connections between technological systems and the shaping of social and political life. As Star and Ruhleder (1996) write, infrastructures are never a background object but a relational concept, they emerge in situ for people in practice, connected to activities and structures, and invisibly embody standards and conventions of a community of practice. Collaboratively designing a self-built CWN system and critically discussing its socio-technical elements meant that the invisible

decisions, ideologies and conventions of a community of practice that are embedded in information infrastructures (Star & Ruhleder, 1996) could be unpacked and negotiated.

This is where the long-term importance of design coalitions for open and collaborative socio-technical infrastructures emerges. Not only as a way to design successful and situated tools, but more importantly as a transitional practice that can reshape and restructure the infrastructures of relations, create solidarities among communities of practice, connect between the everyday realities of those who are privileged and others who are marginalized and build critical infrastructures for a common world (Irani & Silberman, 2014; Lyle et al., 2018; Vlachokyriakos et al., 2018).

The need to prototype tools for future digital sovereignty correlates with current concerns with regard to the creation and management of critical infrastructures in the city, which are mostly expressed in relation to the risks of climate change (Klinenberg, 2016). As Klinenberg and others suggest, critical infrastructures for safeguarding cities are not only about mitigating disaster damage but also about growing awareness to collective vulnerability and addressing dominant political and social institutions (Howe & Boyer, 2016; Klinenberg, 2016). By bringing together the discourses and practices that revolve around urban and technological rights to the city, the MAZI Berlin case study experimented with the possibility of drawing invisible lines between different articulations of critical infrastructures in social, political, urban, environmental and technological realms. These transfigurations of urban infrastructures and imaginations suggests a possible emergence of a political discourse and practice that brings together ideas and techniques which are usually thought of and practiced in isolation.

END NOTES

[1] Through the established nation-state perspective, digital sovereignty conveys state

protection of citizens' privacy rights versus other states (Floridi, 2020; Pohle, 2020; Thiel, 2019), as well as defending democratic procedures against external manipulations through curtailing or countering disinformation campaigns (Thiel, 2021). A second strand focuses on the recalibration of power between the public and private sectors by restraining corporate control over the development, deployment and management of digital infrastructures, data and analysis (Floridi, 2020; Pohle & Thiel, 2020; Thiel, 2019)

[2] It is set closer to ideas such as “food sovereignty” coined by Via Campesina at the World Food Summit in 1996 (Anderson, 2018).

[3] MAZI was conducted between the years 2016–2018 and received funding from the European Union's Horizon 2020 ICT CAPS initiative under grant agreement no 687983. For an overview on the different pilot study activities see <https://mazi.zone.net/mazi-eu/pilot-studies/>

[4] A prototype is an initial model of a product, object or design that is still in stages of development, open for rethinking and iteration (Hackney Blackwell, Manar, & Gale, 2015)

[5] To name a few: Subnodes by Sarah Grant (<http://subnodes.org/>); Open-source urbanism (Corsín Jiménez, 2014), The Civic View from Above (Keysar, 2018), Decidim in Barcelona (Aragón et al., 2017)

[6] Community Informatics can be described as “a sustainable approach to community enrichment that integrates participatory design of information technology resources, popular education, and asset-based development to enhance citizen empowerment and quality of life” Stoecker, 2005, quoted in (Byrum, 2015, 11)

[7] Andreas Unteidig based in the Design Research Lab of the University of the Arts Berlin.

[8] Elizabeth Calderón Lüning lead the NGO Common Grounds e.V., an organization engaged in

socio-ecological transformation from below.

[9] Related efforts have been undertaken by comparing and contrasting the Berlin and London pilots (Gaved, Calderón Lüning, Unteidig, Davies, & Stevens, 2019).

[10] <https://arambartholl.com/dead-drops/>

[11] <https://piratebox.cc/start>

[12] <https://freifunk.net/en/>

[13] <http://www.athenswireless.net/>

[14] <https://www.sarantaporo.gr/en/community-network>

[15] <http://guifi.net/en/>

[16] Open source, modular, single board computer that was adopted widely for community use and education: <https://www.raspberrypi.org/>

[17] <https://github.com/mazi-project/guides/wiki>

[18] The Neighbourhood Academy, existing since 2015, is a self-organized open platform for urban and rural knowledge sharing, cultural practice and activism. <https://nachbarschaftsakademie.org/>

[19] <https://prinzessinnengarten.net/de/home/>

[20] For a list of the initiatives that participated see endnote 28-30.

[21] The term “right-to-the-city” coined by the sociologist and urbanist Henri Lefebvre (1968) in the aftermath of the Parisian occupation, was argued as the “right-of-non-exclusion” from the qualities and services of the urbanized society and as a call to reclaim the city as a co-created space (Holm, 2011; Lefebvre, 1996).

[22] An exact division of phases in time periods is artificial since the phases partly overlap and are to certain extent on-going. Nevertheless, a rough division can be made. The first phase was mainly

based in the first six months of 2016.

[23] From July to August 2016 with continuous reiterations and improvements.

[24] Throughout the project starting in January 2017.

[25] See the complimentary piece for this article. The text incorporated in the depiction is a direct outcome of the first workshop held on the 21st of March 2016. It describes urban political engagements as educational spaces and tries to define the meaning of “collective learning” as understood by the group of participants.

[26] The software, “MAZI-Archive”, was hosted on a hardware setup consisting of a Raspberry Pi 3 (with a 16GB SD-Card), TP-Link TL-MR3020 Wi-Fi Router and an Anker Battery Pack. The router supplies an open Wi-Fi with the SSID “MAZI Archive”, which serves both for the data to be submitted by the recorder-application as well as an access point for users to interact with the content. After some testing in different settings, the MAZI-Archive application was integrated to the default version of the broader MAZI platform.

[27] In addition to that, several independent deployments of MAZI Zones across Germany and abroad (e.g. in Togo & Israel) have been informed by the activities of the Berlin pilot process.

[28] Including Alice-Salomon-Hochschule and Chair for Urban Design Technical University Berlin and University of Arts in Braunschweig.

[29] The Neighbourhood Academy, ZK/U – Centre for Art and Urbanism, the Commons Evening School and the neighborhood centre Kiez Anker 36 in Berlin Kreuzberg

[30] Bizim Kiez, Park Academy, Stadt von Unten, and the Anti-Google-Campus Initiative all active in the neighborhood of Kreuzberg-Friedrichshain in Berlin.

[31] <https://biennalewiki.org/?p=979>

[32] Within such participatory processes, prototypes have been conceptualized as “boundary objects” (Bogers & Horst, 2012; Powell, 2012; Star, 2010; Star & Griesemer, 1989) that allow to rework the designer-user dichotomy and to mediate between different social and epistemic positions.

[33] The neighbourhood center “Kiez Anker 36” has thus far had three follow up projects: “StadtTeilen” (<https://stadtteilen.org/forschung/>) funded by the Robert Bosch Foundation, “PRoSHARE” (<https://jpi-urbaneurope.eu/project/proshare/>) under the European funding program Urban Migration, and “Kiezgeschichten” (<https://stadtprojekte.org/2020/12/kreuzberger-kiezeschichten/>) financed by the German Federal Ministry of Education and research

[34] For example: Miadé (<https://www.dfki.de/en/web/news/detail/News/lokale-community-netzwerke-fr-togo0/>) – Local Community Networks for Togo by the German Research Center for Artificial Intelligence

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