# Let's Do It Online?! Challenges and Lessons for Inclusive Virtual Participation

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Within the broader framework of the EU-H2020 EdiCitNet project—a large-scale collaborative project with a multi-stakeholder approach—there is the opportunity to observe participatory planning approaches to mainstream nature-based, edible solutions to solve specific social urban problems in an international group of six cities—Berlin (Germany), Carthage (Tunisia), Sant Feliu de Llobregat (Spain), Letchworth (United Kingdom), Šempeter pri Gorici (Slovenia), and Lomé (Togo). One year after the project started, the COVID-19 pandemic made it necessary to transfer most participatory planning processes to online platforms. This new format presented challenges to planning and voluntary stakeholder engagement due to different capacities regarding technical requirements as well as location-specific social circumstances. In this paper, we aim to shed light on the potentials and trade-offs in shifting to online participation and who gets to participate under digital Participatory Action Research (PAR) circumstances. We used a mixed-methods approach to evaluate the planning progress and the transition to working online in the six cities during the first wave of the pandemic. The study identifies critical implications of COVID-19 on participatory planning processes, the challenges for online participation, and the effectiveness of measures applied to tackle those challenges. The transition to online participatory planning described in this paper emphasizes organizational rather than technical remedies. While the planning progress in all cities was delayed, some faced significant challenges in the transition to online due to the lack of technical or community capacities. This was fostered through the diverse and new realities of the stakeholders ranging from meeting existential needs to adapting to alternative forms of working and caring. The reflections in this paper offer learnings from the disruptions caused by COVID-19 to better understand how participatory planning processes can be managed online along the lines of equity, access, and participation. The findings demonstrate how participatory processes in the ongoing crisis can be maintained, with relevance to future waves of this and other pandemics.

**Keywords: co-creation, COVID-19 pandemic, local food systems, participatory planning, social engagement, transdisciplinarity, virtual participation, digital equity**

# INTRODUCTION

Participatory planning, as an inclusive and empowering approach, brings people together and integrates different knowledges, experiences, and interests to solve a specific problem (Foth, 2017). For this reason, citizen participation has become an essential aspect of (urban) planning (Arnstein, 1969; Willness et al., 2019). The COVID-19 pandemic posed new challenges for citizen participation: first, the associated social distancing measures made traditional face-to-face participation methods impossible, challenging the value of in-person relationships of participation; and second, the adverse socio-economic consequences of COVID-19 hindered citizen engagement, raising questions about who is able to participate. Overcoming these challenges is essential as citizen participation is pivotal to the creation of just and sustainable cities (Shuib et al., 2015; van der Jagt et al., 2017).

Edible Cities Network (EdiCitNet), an H2020 project, allowed us to observe, while also actively engaged in resolving, the disruptions to participatory planning processes as a result of COVID-19—particularly from March to October 2020. In this project, six cities are developing contributions to urban masterplans to anchor the fostering and implementation of Edible City Solutions[1] (ECS) and its co-benefits in urban planning: Berlin (Germany), Carthage (Tunisia), Sant Feliu de Llobregat (Spain), Letchworth (United Kingdom), Šempeter pri Gorici (Slovenia), and Lomé (Togo). ECS are part of, and go beyond, the concept of Nature-based Solutions (NbS) that focus on shared production, processing, consumption, and distribution of food (Säumel et al., 2019). ECS are used as instruments in the planning process to tackle specific social challenges, for instance, to increase the quality of life in disadvantaged neighborhoods, promote intergenerational exchange and communication, or integrate refugees. This transdisciplinary approach, involving participants from different sectors in each city, including city administrators, NGOs, and residents' groups, as well as researchers from a range of disciplines, was initially designed as face-to-face planning. COVID-19 made it necessary to shift those activities in to the virtual space as the pandemic disrupted the process prior to the commencement of the face-to-face activities. An exploration of available online collaboration and communication tools became a priority to maintain the participatory planning processes.

Even without such disruptions, participatory approaches can prove challenging in practice, requiring specific considerations to succeed (Shuib et al., 2015; Tornaghi and Van Dyck, 2015; Raymond et al., 2017). To engage stakeholders, respectful

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**Abbreviations:** ECS, Edible City Solutions; EdiCitNet, Edible City Networks; hub, Research and small and medium enterprise; NbS, Nature-based Solutions; TPM, Transition Pathway Methodology; PAR, Participatory Action Research.

[1]ECS as definied through the EdiCitNet consortium "amplify benefits provided by Nature-based Solutions from supply of regulating and cultural ecosystem services… that address food security, poverty alleviation, and inequality in urban areas… ECS are promising to sustainably contribute to reducing socio-economic and environmental problems…" (Grant Agreement No. 77666). Furthermore, ECS can foster environmental and economic co-benefits associated with NbS, in addition to supporting regional food production including local food networks and promoting a high variety of other social benefits (Säumel et al., 2019).

interaction, trust between participants and the creation of a shared understanding of the goal are required (Umemoto, 2001; Höppner et al., 2007; Gordon and Manosevitch, 2011). Facilitated face-to-face interactions between stakeholders are seen as crucial in enabling people to share ideas, build trust and create plans, for instance, during workshops and focus group discussions (Fitze, 2006; Bachour et al., 2010).

During the pandemic, online tools have been widely applied in business, administration, and education to enable management, planning, and teaching. They are now often seen as a suitable and cheaper way to manage former face-to-face activities (Norman et al., 2010; Sidpra et al., 2020). In cases where infrastructure is equally accessible to all participants, online participation has the potential to widen access by enabling more voices to be heard; while face-to-face interactions creating in-person relationships between the participants may allow a greater depth of understanding, depending on the goals sought (Piatkowski et al., 2017; Glaas et al., 2020). However, it is also acknowledged that maintaining virtual interactions in teaching (Adedoyin and Soykan, 2020) or management (Caligiuri et al., 2020; Van Assche and Lundan, 2020) during COVID-19 remains challenging. Concerns include questions of capability (of users and organizations) and of accessibility and infrastructure, potentially excluding "individual learners and citizens and… whole populations" (Resta and Laferrière, 2008, p. 766). Given the nature of participatory processes and the particular importance of trust-building, it is crucial to be aware of the obstacles that online participation might represent for planning processes that engender inclusivity. Designing online participatory processes and selecting the appropriate online tools remains an important consideration throughout implementation and progress monitoring (Afzalan et al., 2017).

This paper aims to share how we identified and responded to the challenges of implementing participatory planning processes online and how we observed and facilitated this shift. We further evaluated the planning process in the cities, each of which faced different technical and social challenges prior to and during this shift. Some cities managed the transition with comparably minor problems, for instance, Berlin with a high level of participants' digital literacy and motivation. Other cities needed time to navigate the new situation, as in the case of Lomé with unstable digital infrastructure, or even withdrew from the project, as in Letchworth, due to economic pressures posed by the pandemic. Although this paper focuses on rather organizational and technical elements, we demonstrate that technical and organizational hurdles have important social dimensions. We reflect on digital equity, a concept that has gained traction during the pandemic. Here, we focus on access to hardware, available connectivity and bandwidth, and the quality of time to participate (Solomon, 2002). This is of specific relevance for this study as community engagement, and equitable relations is a core component of the project itself (Resta and Laferrière, 2008; Aguilar, 2020). Within this debate, our reflections challenge the often underlying assumption—seen in the concept of "Smart Cities" itself, which sees digital technologies (and with them their accessibility) as being key to fostering equity—that citizens have equivalent

access, skills, and time to participate in digital activities (Batty et al., 2012).

In providing insights on how we transitioned from a face-to-face to an online Participatory Action Research (PAR) process during COVID-19, we:

I identify the most relevant impacts of COVID-19 on the participatory planning process in the six cities;

II describe the measures taken to mitigate the effects of COVID-19 on the planning process;

III evaluate the participatory planning progress for each city;

IV discuss the challenges of transferring participatory planning processes to an online format;

V reflect on the aspects of digital equity observed in the transition process.

## DESCRIPTION OF THE CASE STUDY

Rapidly growing cities have become centers of resource consumption and environmental pollution (Rees and Wackernagel, 2008; Carta et al., 2017) and face increasing pressure to act upon these (Kahn, 2007). ECS stimulate the promotion of sustainable management strategies for addressing socio-environmental challenges by, for instance, supporting circular economies and providing social benefits for citizens (Faivre et al., 2017; Lafortezza and Sanesi, 2019; Säumel et al., 2019).

A growing body of research on city-level initiatives such as food policy councils, food strategies, food networks, and food hubs proves the relevance of the concept of ECS, rooted in the long history of urban agriculture, alternative food networks, and other urban nature initiatives (Goodman et al., 2012; Grasseni, 2013; Santo et al., 2017; Corsi et al., 2018; Moragues-Faus and Sonnino, 2018).

To tackle COVID-19-induced food insecurity and inequalities—with the most vulnerable carrying the worst impacts—more resilient local food systems are needed (Lal, 2020; Bellamy et al., 2021). Here alternative models of food production and social organization, for instance, as found within the agroecology movement, are gaining ground within this societal debate to advance an innovative "post-COVID-agriculture" (Altieri and Nicholls, 2020).

Introducing such concepts and ideas at the level of urban planning became an essential component of social acceptance and ownership (Allam and Jones, 2020). This manifested particularly as the pandemic highlighted the need for recreational areas and public green spaces and the inclusion of key stakeholders such as citizens, amongst others (Galimberti et al., 2020; Sharifi and Khavarian-Garmsir, 2020).

## Participatory Planning Approaches for More Sustainable Cities: Transition Pathway Methodology

Firstly, urban agriculture initiatives, as one form of ECS, are often established as a grassroots approach initiated, led, and maintained by local volunteers. Simultaneously many ECS depend, at least partially, on support from city administrations for their continuation, further promotion, and scaling out—including connecting different food territories and initiatives (Edwards et al., 2018). Secondly, many pressing urban social challenges, such as crime or deterioration of neighborhoods, are wicked problems that are ill-defined and involve many uncertainties (Churchman, 1967). Because of the limited problem-solving capacity of single disciplinary perspectives, solving such complex challenges requires the integration of many different stakeholders' perspectives e.g., citizens, initiatives, city administration, academia, and NGOs (Frischknecht and Schmied, 2002; Mittelstraß, 2005; Checkland and Holwell, 2007; Lang et al., 2012). The mutual dependencies found in wicked problems, therefore, call for a transdisciplinary approach to planning.

The Transition Pathway Methodology (TPM) used in the project sits within the tradition of transdisciplinary research—an approach that integrates perspectives from different disciplines and stakeholders (Mittelstraß, 2005; Lang et al., 2012). Transdisciplinary research was introduced in the 1970's to recognize the societal responsibility of research institutions and mainly aims to tackle complex, real-world problems by integrating knowledge from all stakeholders. This includes sectoral and academic specialists to co-create research and co-develop solutions through iterative cycles involving action and reflection (Hadorn et al., 2008a,b). The ownership and active collaboration promoted in this planning process follow transdisciplinary criteria, including reflexivity, and inclusion (Strydom and Puren, 2014; Belcher et al., 2016). Following the transdisciplinary case study approach of Scholz and Tietje (2002), TPM depends on a high level of multi-stakeholder participation with the aim of transferring decision-making power to the participants (Arnstein, 1969).[2] It centers on the concerns of those with the everyday experience, treating stakeholders' perspectives and their feedback on researchers' input as core elements of a planning procedure.

Citizens in the project under discussion thus became co-creators of transdisciplinary research and planning processes for the co-generation of knowledge. This began with reaching an understanding of the current situation in order to formulate pathways toward positive change (Jarke, 2021). The resulting outputs of the TPM application are masterplans for ECS representing collectively agreed and desirable shared futures of the involved stakeholders and the pathway to achieving these futures.

Increasing recognition of participatory processes in urban development reflects a change in the emphasis of urban planners. No longer are citizens simply seen as residents or consumers, but rather as participants in planning processes and co-creators of urban spaces (Foth, 2017). ECS initiatives are more effective at targeting social challenges if participation embraces the principles of inclusivity and empowerment of previously disempowered voices and is not co-opted to create a

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[2]The TPM aims to truly delegate decisions to the stakeholders and put them partly into control (Arnstein, 1969).

veneer that outcomes are the result of what people want (Cooke and Kothari, 2001).

To organize this inclusive and empowering participation in the planning process of ECS, we apply the TPM (see **Figure 1**; Freyer et al., 2005; Manderscheid et al., 2019). TPM was developed as a methodological approach to structure and operationalize complex planning processes, including three steps, in which involved stakeholders co-create the transition pathways in three phases (**Figure 1**; Manderscheid et al., 2019):

1. System development—city-teams create a system model to better understand the status quo of the city
2. Scenario development—city-teams create different scenarios to overcome the chosen societal challenge using ECS
3. Transfer development—city-teams evaluate the scenarios, select the most beneficial one and develop an implementation plan.

Prior to COVID-19, many methods that enable participation have relied on face-to-face interactions (Hadorn et al., 2008a), which have been seen as crucial enablers of transdisciplinarity (Olson and Olson, 2000; Stokols, 2006). Furthermore, the TPM has sought to bring together the following stakeholders in each city in the form of city-teams[3]:

- **Representatives of the city administration and various local stakeholders** relevant to the establishment of ECS (ECS owners,[4] representatives of relevant NGOs, small and medium enterprises, engaged citizens, etc.)
- **Local researchers** organized as research hubs supporting the city-team in the facilitation of the TPM
- **Researchers from the University of Natural Resources and Life Sciences, Vienna (BOKU)** mentoring the TPM—while constantly reflecting and adapting to the local needs.

**Table 1** shows the different constellations of the city-teams indicating the diversity, variation in size, and organizational affiliation. This diverse representation of stakeholders is strongly linked to the local requirements and goals articulated by participants in each city, as well as to the underlying PAR approach and project internal ethical guidelines. Additionally, the table indicates how many city-team members are employed through official partners of the EdiCitNet project.

Prior to COVID-19 restrictions, each of these city-teams was meant to hold a multi-day face-to-face workshop—in each phase of the TPM—developing core content in various work steps. City-teams were scheduled to start the planning process in early 2020 and to complete the task in late 2021. The first (TPM) phase was due for completion in September 2020 (**Figure 1**), including several steps:

[3]According to the projects' governance guidelines one city-team coordinator (part of the consortium) is organizing a city-team of different stakeholders. The city-team coordinators and the respective research hubs are key people for knowledge creation connecting the project consortium to each city, in addition to hosting the implementation of the TPM. These city-teams are open to new members along the process (Edwards et al., 2018).

[4]The term ECS owner refers to the persons or organizations that are running the ECS and have decision-making power.

- **Definition of social problems**: City-teams discuss urban challenges and select and define a social problem they would like to tackle with ECS
- **Documentation of relevant ECS**: City-teams document existing ECS in their cities to understand what solutions are already available
- **Identification of relevant fields of action**: City-teams define the major areas to be considered to successfully foster suitable ECS toward addressing the defined social problems.
- **Identification of influence factors:** Based on the collected information, city-teams define and describe influential factors that, in turn, play an important role in fostering ECS.

## Disruption Through COVID-19

At the beginning of the first phase of TPM, COVID-19 disrupted the EdiCitNet project. To better understand the different levels of severity of COVID-19 in the cities and its implications on the city-teams, **Table 2** briefly describes the restrictions in each city. This shows that all cities have been affected at different levels by infection control measures.

As the Letchworth Garden City Heritage Foundation (LGCHF)—the official partner of EdiCitNet in Letchworth—was hit hard by the pandemic, the only option was the immediate withdrawal from the project. Therefore, as we specifically seek to understand the constraints of converting the process to online platforms, our reflection of the Letchworth case, which did not undergo this transition, will be limited.

## Mitigation Measures

With the need to transition the PAR process online, the following categories developed by Afzalan et al. (2017) proved valuable when considering the potential barriers to the adoption and effective use of online tools:

- the organizational capacity of the planners, i.e., the skills, attitudes, and resources of the planners to implement online planning tools and to manage and monitor the process.
- the community capacity, i.e., the skills, attitude, and resources of the participants to actively participate.
- the norms and regulations in place that could affect the use of online tools.
- the scale and complexity of the planning problem and the goals of the participation.
- the technical capabilities of the planners and the participants, i.e., if the skills and IT infrastructure needed are available.
- the tool capacity, i.e., the efficiency of the tool and the ability to foster the decision process, leadership, and the creation of a good atmosphere and conflict management.

However, in our case, detailed assessments of these categories were not possible as COVID-19 forced us to act quickly. The most immediate mitigation measure was to transfer face-to-face interactions to virtual platforms to secure the continuation of the planning process. This included the provision of online communication and collaboration tools and training for all city-teams to conduct all activities of the first phase of TPM (system development) online. Adaptation strategies included:

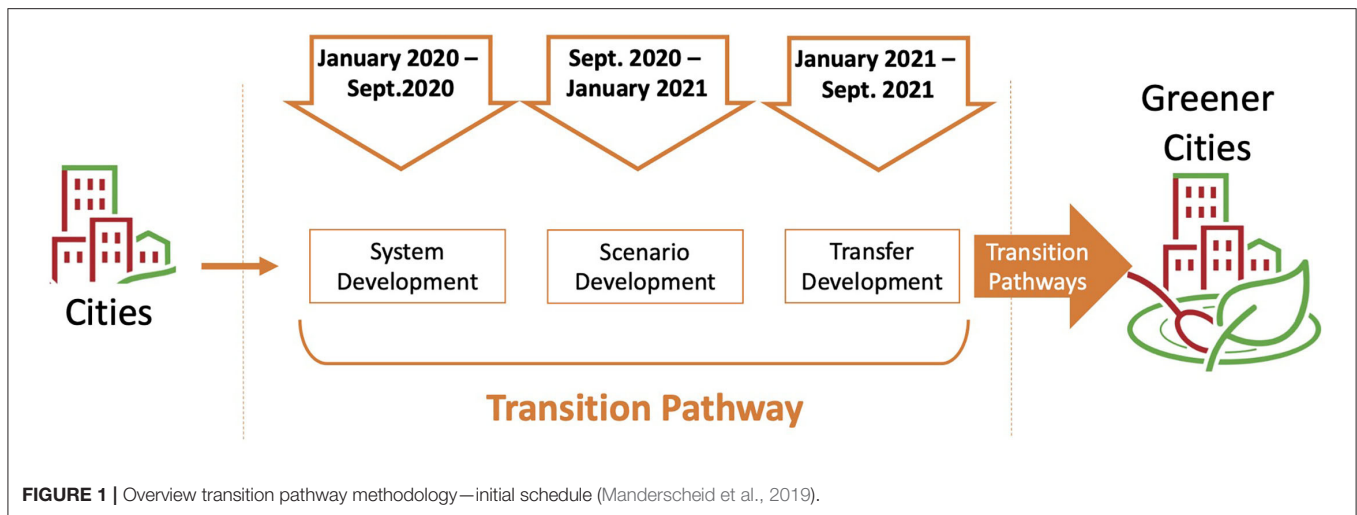**FIGURE 1 |** Overview transition pathway methodology—initial schedule (Manderscheid et al., 2019).

**TABLE 1 |** Number of participants of the participatory planing process as initally planned (*Schools, supramunicipal managerial entity, **incl. public, community, network, association, cooperative, foundation, ***not represented in other category) and employed city-team members through the EdiCitNet project.

| City | Berlin | Carthage | Letch-worth | Lomé | Sant Feliu de L. | Šempeter pri Gorici |
|------|--------|----------|-------------|------|------------------|---------------------|
| City council | 5 | 3 | – | 7 | 11 | 3 |
| Public institution* | – | – | – | – | 4 | 3 |
| Researchers | 2 | 4 | 3 | 5 | – | 1 |
| SMEs | 2 | – | 1 | – | 1 | 7 |
| NGO** | 5 | – | 2 | – | 18 | 5 |
| Citizens*** | – | 6 | 1 | – | 1 | - |
| Total number of participants | **14** | **13** | **7** | **12** | **35** | **16** |
| Employed through EdiCitNet project | **4** | **5** | **3** | **3** | **6** | **3** |

- **Online course platform**—A Moodle course for each city was created, guiding the cities through the four steps of the first phase (see Section Participatory Planning Approaches for More Sustainable Cities: Transition Pathway Methodology) of TPM.
- **Online communication tools** such as chats, forums, or tools for videoconferences (mainly, Zoom, Skype, WhatsApp, MS Teams, and Blue Jeans) were offered to the city-teams.
- **Online collaboration tools** (such as Google Docs, Mindmeister, Mural, and MS Teams) were offered for documentation or brainstorming platforms to better integrate all ideas, thoughts, and work within each city-team).
- **Extension of deadlines** was granted project internally and by the funder to enable the city-teams to reschedule their tasks and organize online engagement while taking pressure from city-team coordination.
- **Increased support** by BOKU, project coordinator and supporting hubs for the participatory planning process. Individual strategies were developed to ensure the participation of city-team members in support of the overall project goals. This was also provided through information material and guidelines on the introduced tools and the

adapted process, such as a masterplan template including all steps to fulfill the TPM.
- **Splitting up tasks** was introduced to divide the process into smaller units that could be achieved online over a longer period.

After the initial attempt to roll out the same software-based tools in all cities, modifications have been necessary for response to the preferences expressed by each city-team. Besides these mitigation measures provided by the project, some cities also developed their own strategies to adapt the participatory planning process (e.g. holding outdoor meetings or limited participant numbers in workshops).

## METHODS FOR DATA COLLECTION AND ANALYSIS

The impacts of COVID-19 on the participatory planning process were investigated in six EdiCitNet cities. After the process transitioned to online platforms, we conducted an analysis of the progress of implementing the TPM in the given timeframe (March to October 2020) in each city. This included data on participation in meetings with city-teams during the study period

| City | Measures active | Restrictions |
|---|---|---|
| Berlin[a] | March—May 2020 | • Lockdown including closing of shops, schools, universities, sports, and culture<br>• Meetings with more than 50 people were prohibited<br>• Individual, organizational, and institution-wide restriction measures were stricter |
| Carthage (and wider Tunisia)[b] | March—May 2020 | • Lockdown including all non-essential travel and closing of shops, schools, universities, sports, and culture<br>• Locally adapted measures (e.g., meeting restrictions, night curfews) depending on the infection rates after May |
| Lomé[c] | March—June 2020 | • State of emergency including a night curfew, the launch of a cash transfer program and free water and electricity for the most vulnerable, and support measures to sustain agricultural production and to ensure self-sufficiency[d]<br>• Closure of shops, schools, universities, sports, and culture |
| Sant Feliu de Llobregat[e] | March—June 2020 | • Closure closing of shops, schools, universities, sports, culture, public network centers, and several services<br>• Higher infection rates brought new infection control measures such as night and day curfews. |
| Sempeter pri Gorici[f] | March—May 2020 and October 2020 | • State of emergency prohibiting movement between municipalities and meetings<br>• May till October 2020 traveling, and meeting was allowed in accordance with infection control measures (i.e., wearing of masks, distancing and disinfection rules)<br>• Meetings remained possible under restrictions and with a maximum number of six people |

[a] *Christliche Demokratische Union Deutschland (2021)* and *Senatskanzlei Berlin (2021).*
[b] *A3M Global Monitoring GmbH (2020)* and *Auswaertiges Amt (2021).*
[c] *World Health Organization and Republique Togolaise (2020).*
[d] *This safety net is remaining from the recent Ebola pandemic in Lomé and helped to respond faster to COVID-19.*
[e] *Generalitat de Catalunya (2021).*
[f] *Republika Slovenija Gov.si (2021), Sledilnik (2021),* and *TriTim Spletna Agencija (2021).*

(March to October 2020), the internal and external project reporting and documentation, and the activities of the online platforms. The external project reporting consisted of project deliverables [e.g., Deliverable 4.3—Documentation of ECS in Follower Cities (Manderscheid et al., 2020)]. Internal reporting consisted of meeting minutes and monthly presentations in the Executive Board meetings of the project. Additionally, this includes protocols and reflections from meetings between BOKU, the project coordinator, and members of the city-teams tasked with setting up, adapting, and supporting the transition of the participatory planning process to the online format. All measures listed above were first piloted in Berlin—as this fitted with the city-team activities schedule—to understand better the applicability and potential to support the online transition. To adopt the measures to the local needs of all cities, 23 individual city meetings took place between the city-team coordination, the facilitation (BOKU), the respective research hub, and the overall project coordination (**Table 3**). These meetings were essential to design, set up the TPM within EdiCitNet, discuss what mitigation measures to take, and reflect and adapt the measures in place according to the usability (including the question of digital infrastructure and its availability), acceptance, and benefits.

Reflecting on project activities, we also analyzed the state of progress for the online platform providing an overview of the different online and offline activities that each city-team had undertaken to move forward in the planning process. We then identified the planning progress of each city within the given timeframe (i.e., what working steps were completed using which methods). The analysis of the online planning progress and reflections from the coordination meetings provided insights into

the challenges experienced during the planning process under COVID-19 restrictions. This data faced limitations regarding participants' challenges on the individual level.

Complementing this analysis, key members of each city-team and connected research hubs were asked to assess the impacts of COVID-19 on the city-teams and the planning process in both an online survey and semi-structured interviews conducted between August and October 2020. While these were sent to all city-team members, one representative per city was appointed by each city-team to complete the online survey resulting in six surveys. Survey respondents were asked to rank from one (low) to five (high; Bortz and Döring, 2006): How strongly COVID-19 affected their city; the city-team members; and the work of the city-team. Survey respondents were also asked to identify in open questions the three most relevant impacts of COVID-19 on their city and the work of their city-team. They were then asked to rank from one (low) to five (high): these impacts of COVID-19; the usefulness of the mitigation measures; and the potential of ECS strategies to serve as potential solutions to negate the COVID-19 impacts identified. In five cities, semi-structured qualitative interviews were conducted (Berlin, Lomé, Letchworth, Šempeter pri Gorici, Sant Feliu de Llobregat). These were transcribed and coded using the constant comparison and saturation approach (Rivas, 2012). The combined data provided insights into how COVID-19 affected the city-teams and the participatory process. Given the number of participants involved in each city-team these data and resulting insights proved representative and valuable to the PAR process as COVID-19 unfolded.

To better understand the following sections of the paper, we point out some of the significant limitations here. The assessment

**TABLE 3 |** Coordination meetings to transition the participatory planning process to online from March—October 2020 (Letchworth withdrew before any transition of the participatory process to an online format).

| City | Berlin | Carthage | Letchworth | Lomé | Sant Feliu de Llobregat | Šempeter pri Gorici |
|---|---|---|---|---|---|---|
| Number of coordination meetings | 8 | 6 | – | 3 | 2 | 4 |

of COVID-19-related impacts on the city-teams only represents the perception of the city-team coordinators or connected hubs after the first wave of the pandemic. One limitation of our research was that many potential interviewees were not available to participate due to the general uncertainty posed by COVID-19. Working with the city-team coordination provided us with insights into the planning processes and differences between cities but has not offered a deeper analysis of the dynamics within the city-teams. City-team constellations have been changing over time, especially in the COVID-19 crisis. Since the first wave of the pandemic, city-team members and coordinators have been shifting. On the coordination level, there were changes, for instance, due to new institutions taking the lead or partners dropping out, some of our interviewees in 2020 have since then left the project. We were, therefore, unable to collect complete demographics and unravel how gendered and other social dynamics might have impacted the city-teams and the transition process, especially in the long run. Therefore, any analysis of digital equity, based on the interviews and observations, was done at the city-level as a comparative analysis of socio-technical aspects between the cities.

## RESULTS—ANALYZING COVID-19 IMPACTS AND CHALLENGES ON PARTICIPATORY PLANNING

This section highlights the challenges for the participatory planning process that emerged due to COVID-19 and the resulting shift to online participation. We present data on COVID-19 impacts as experienced by the city-teams collected during observations, interviews, and the online survey. We then describe each city-team's planning progress during COVID-19 in response to the mitigation measures taken. Finally, from a facilitator's perspective, we reflect on the issue of digital equity as a precondition for such participatory online processes.

### Perceived COVID-19 Impacts on the City-Teams

**Table 4** illustrates the survey respondents ranking of the severity of COVID-19 on their city-team and the types of impact of COVID-19 on the city-team. The data shows almost all city-teams being (highly) affected, with imposed restrictions such as curfews and quarantine inhibiting economic activities. This limited planning meetings (e.g., regulations to meet at all or limited number of allowed people) and imposed strict hygiene protocols

that required, for instance, hand sanitizers and face masks.

The impacts of COVID-19 on the city-teams of Berlin, Šempeter pri Gorici, and Lomé were ranked *moderate,* where these teams faced communication and collaboration challenges affecting the planning progress. In Berlin, for example, city-team members were challenged due to the closure of schools and kindergartens, mentioned by the interviewee as the main reason "because they [the city-team members] suddenly had to deal with completely different things…" (Interview[5]). In Lomé, the *high* ranking of the impact on the city-team members is in line with the strict local restrictions. In Šempeter pri Gorici, the city-team members experienced economic pressure, whereas the continuation of the TPM has only been *mildly* affected. As one interviewee stated, "[the impact of COVID-19] … wasn't so hard because… life in our municipality goes on not very affected." (Interview[6]).

In Sant Feliu de Llobregat, city-team members dropped out, and no meetings were possible to continue TPM as "beginning March to beginning July (2020), it has been COVID-19, 100 percent… [for the city administration]" (Interview[7]). The economy was impacted, resulting in unemployment, and citizens of Sant Feliu de Llobregat demanded alternative food supplies such as local markets and food cooperatives to stay accessible while initially being prohibited under the infection control measures. With the disruption to food distribution, the need to stabilize supply, and the urge to support local producers' alternative food networks were increasingly viewed as multi-beneficial solutions. For Lomé, due to economic pressures, such as job loss or precarious, short-time work, and reduced business operating hours, citizens were challenged to cover their basic needs such as food. Therefore, a state of emergency was announced, immediately activating support measures (**Table 2**).

### Experiences With (Online) Mitigation Measures

As discussed in the methods, the mitigation measures adopted by the project included three digital pathways (online course platform, online communication, and online collaboration tools) and three non-digital organizational measures (extension of deadlines, increased support, and splitting up tasks). Overall, the organizational measures were considered immediately helpful in providing the space to take on the online tools. Consequently, all cities applied these management measures offering more time and flexibility to introduce the online measures.

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[5]Interview 26.08.2020.
[6]Interview 26.08.2020.
[7]Interview 14.10.2020.

**TABLE 4 |** Assessment of the severity of COVID-19 impacts (ranked by city coordination or hub during the survey 1 = low; 5 = high) and most relevant COVID-19 impacts on city-team members.

| Cities | COVID-19 | |
| --- | --- | --- |
| | …impact ranking | …reported impacts |
| Berlin | 4 | Hindered communication between city-team members; delays in contributions |
| Carthage | 3 | Limited physical meetings; delays in decision meeting; loss of efficiency due to uncertainty |
| Letchworth | 5 | Suspension of the planning process |
| Lomé | 4 | Curfews; no physical meetings; hygiene protocols |
| Šempeter pri Gorici | 4 | No large events; negative economic effects on city-team members; digitalization of municipality |
| Sant Feliu de Llobregat | 2 | No physical meetings; no new city-team members; exhaustion of staff |

In **Table 5**, the survey respondents ranked the digital and non-digital measures to aid and facilitate collaborative planning under COVID-19 restrictions. Most measures were considered very useful, except for the online platform and collaboration tools by Carthage, Sant Feliu de Llobregat, and Šempeter pri Gorici. Independent of the evaluation of the mitigation tools, all cities indicated that they faced challenges in continuing the process online during the crisis.

Online measures and tools were trialed in Berlin but needed additional adaptation along the process in each city individually. It became clear that time to pilot and introduce the transition is a crucial component to accustom to the modes and tools of online collaboration. For instance, as the city-team of Sant Feliu de Llobregat started later with the TPM in general, the team struggled with the online process as "…it [the (online) TPM] was not launched… that was the problem, and they [the city-team] have to learn" (Interview[8]). The piloting in Berlin shows that even under ideal conditions—good infrastructure and a high rate of digital literacy and motivation—the planned transition could not be transferred one-to-one to online collaboration as designed but required individual adaptations. For instance, the Moodle, rather than being a space for active interaction amongst city-team members, was used as a steering platform for the city administrations and research hubs, leading the city-teams in all cities that underwent the transition to online through the different steps of the TPM. As the ranking of the usefulness indicates, all cities (except Šempeter pri Gorici) introduced online communication tools successfully. To ensure this, the frequency and duration of online communications were under constant review and adaptation to meet city-team capacities.

The online collaboration tools were the most challenging mitigation measure applied. In Berlin and Carthage, these were found to be useful, and after an initial introduction explaining usability and functionality, the city-teams used the tools, for instance, for the brainstorming on the social challenges to be tackled in the respective cities. Šempeter pri Gorici explored different means of exchange and interaction by choosing instead to host outdoor meetings. Lomé and Sant Feliu de Llobregat paused the city-team activities until, in Lomé, face-to-face meetings were possible again. Sant

Feliu de Llobregat restarted their activities once the so-called "new normal" was established, including, amongst others, hygiene and home-office rules, childcare facilities, and school reopening.

## The Progress of Participatory Planning During COVID-19

As seen above, COVID-19 affected the continuation of TPM in each city, putting pressure on citizens and forcing city administrations to focus on crisis management. **Table 6** provides an overview of the planning progress of the city-teams as the most stringent COVID-19 measures were imposed. It illustrates the discrepancy between the planned and actual working steps of the first TPM phase. None of the cities was able to start steps 3 and 4 until September 2020—due to the COVID-related delays, which were rescheduled with the extension provided. We, therefore, focus here on steps 1 and 2. Some cities were unable to finish all tasks in working steps 1 and 2 due to the new modes of working or the general interruption of the activities. This indicates that the impacts of COVID-19 on the TPM could not simply be mitigated by transferring the tasks to online platforms and tools. Furthermore, it became clear that despite the provision of online tools and their indicated usefulness, these tools might not have been used, for instance, because in Lomé due to unstable internet connectivity and low bandwidth.

The cities that faced the most significant delays in the planning progress were Lomé and Sant Feliu de Llobregat. The process had to be put on hold for several months due to severe pressures on the municipalities caused by COVID-19. The less affected city-teams of Berlin and Carthage continued the planning activities with adapted means and frequency of interaction. However, as one interviewee stated:

"I [city-team coordinator] wrote a lot of e-mails because only Moodle would not have worked… I always communicated in between until the point where we lost the participants... but at some point, my capacities were simply exhausted." (Interview[9]).

[8]Interview 14.10.2020.

[9]Interview 26.08.2020.

**TABLE 5 |** Evaluation of the usefulness of mitigation measures from 0 (not helpful) to 5 (very helpful).

| Cities | Usefulness of mitigation measures for planning process | | | | | | |
|---|---|---|---|---|---|---|---|
| | Online course platform | Online communication tools | Online collaboration tools | Extension of deadlines | Increased support | Splitting up tasks | Own measures |
| Berlin | 5 | 4 | 4 | 4 | 5 | 5 | 5 |
| Carthage | 1 | 3 | 3 | 4 | 3 | 3 | 4 |
| Lomé | 5 | 4 | 2 | 5 | 5 | 4 | 4 |
| Šempeter pri Gorici | 4 | 5 | – | 2 | 4 | 4.5 | 5 |
| Sant Feliu de Llobregat | 0 | 3 | 1 | 5 | 4 | 2 | 5 |

**TABLE 6 |** Evaluation planning progress.

| Steps | Tasks | Berlin | Carthage | Lomé | Sant Feliu de Llobregat | Šempeter pri Gorici |
|---|---|---|---|---|---|---|
| Step 1: Identification of social problem and geographical area | Brainstorming social problem | Online | Online | – | – | Offline |
| | Description social problem | Online | Online | – | Offline | Offline |
| | Discussion problem and area | Online | – | Online | – | Offline |
| | Finalization | Online | Online | – | – | Offline |
| Step 2: Identification of relevant ECS | Brainstorming existing ECS | Online | – | – | – | Offline |
| | Informing about data collection methods | Online | Online | Online | Online | Offline |
| | Documentation of ECS | Online | Online | – | – | Offline/ Online |
| | Discussion of relevant ECS | Online | – | – | – | – |

**Table 6** also shows which participating city-teams conducted different steps online or offline. The transfer to virtual space proved to be the only option for some city-teams to continue the planning process and to provide the opportunity for participation. Within these city-teams, comparable numbers of people were employed through the EdiCitNet project (**Table 1**). With varying sizes of city-teams, this correlates with the higher or lower intensity of support given. The deduction that city-teams with higher shares of employed staff progressed more in the online transition—Šempeter pri Gorici and Letchworth form exceptions in this regard—needs to consider the multicausal and complex circumstances of crisis.

A notable exception is Šempeter pri Gorici, which was able to continue some planning offline in the outdoors while progressing the most in the TPM during this period. This was necessitated by city-team members being unfamiliar with the IT infrastructure in general, with less restrictive infection control measures allowing people to meet outdoors. This was also the case, although to a lesser extent, for Carthage, where the city-team completed some tasks face-to-face, and online tools were used less frequently for collaboration.

## Digital Equity—A Facilitators' Reflection

We reflect on and challenge the assumption by Batty et al. (2012) that all citizens have the same playing field when it comes to digital use and interaction. Transitioning to online tools in the diverse group of international cities and city-teams required that the specific local context regarding available infrastructure, and citizen preferences, needs, and interests be taken into consideration. While some of these aspects in different cities and contexts were often thought to be on the same or at a similar level across all city-teams, this led to wrong assumptions regarding the starting points of each city, neglecting the existing (infra-)structures and dynamics of digital inequity between the cities, if not in the city-teams themselves. This section describes our learning process of the cross-sectional issue of digital equity, taking into consideration differential access to hardware, available connectivity and bandwidth, and the quality of time to participate (Solomon, 2002).

The online transition of the TPM was centered around the following questions: how can we move the different participatory steps of TPM to online formats; which tools can support this process? In Lomé, the internet connections—mainly provided

through mobile phones—of city-team members failed, and collaboration with digital tools was impossible as working, for instance, with interactive whiteboards consumes a lot of bandwidth. Therefore, the question of participation was focused on access and connectivity. To address this, the first step for an online transition was to establish a stable internet infrastructure. In Berlin and Carthage, on the other hand, where connectivity was stable and bandwidth good, city-teams were able and engaged with the online process shortly after the outbreak of the pandemic. This suggests that access to hardware and available connectivity may be central (localized) limitations. However, in all cases, we must critically ask who the involved city-team members were.

In Šempeter pri Gorici, as stated by an interviewee, the city-team was on average older and reported having little experience with computers, the internet, and online tools. Thus, the lack of digital expertise proved to be a major challenge. The city-team of Sant Feliu de Llobregat faced the same challenge. As one interviewee stated, city team members were eager to learn how to use these digital tools, but to do so, physical meetings would have been necessary. In terms of digital equity, according to these examples, we saw new sets of marginalized groups arise, varying from people without online access, parents taking over care duties and lacking time to participate, and those who are older and unfamiliar with digital activities and tools. This shows the necessity to put more emphasis on the city-team members' realities in terms of their preferences, needs, and interests as well as skills.

The online transition process was piloted in Berlin. Compared with the other cities, this was piloting for an (under the circumstances) best-case scenario wherein volunteers were committed and had the necessary time and resources to contribute. Even in the relatively successful example of Berlin, one female city-team member in Berlin could not be part of the team anymore as "I just have to take care of the home-schooling of my children now" (Interview[10]). This underlines the challenges for marginalized groups and, at the same time, highlights the importance of digital equity in terms of the quality of time to participate. Here and in other cities, city-team members were seen as representatives of particular stakeholder groups, for example, NGOs, SMEs, or city administrations. This being of higher priority for the process than the equitable representation of society opens the question of structural marginalization regarding the diversity represented in city-teams.

Even though the city-team coordination and hubs co-designed and continuously adapted the online process, there are limitations according to the individual dynamics at the level of the city-team members. Some of them were confronted with taking care of existential needs, such as finding alternative food sources in Sant Feliu de Llobregat or coping with rising unemployment rates in Lomé. Others had to adapt to alternative forms of working and caring. Further, the quality of exchanges and collaboration was limited by reverting to online tools.

Therefore, it became clear that to ensure digital participation to the most inclusive level possible, the transition process needed

city-team tailored approaches, including, for instance, meeting frequencies and durations as well as tools and formats to use. These adaptations focused on those city-team members who were able to participate under the circumstances rather than on those who found themselves unable to continue providing their time. This resulted in the latter group being marginalized and leads to the question of how to segregate and integrate these groups again. At the same time, it demonstrated the various levels of depth this online TPM could reach in the different cities—while exchanging *via* digital whiteboards was possible for the city-teams in Berlin or Carthage, others were challenged by any participatory online activity as Šempeter pri Gorici or Lomé.

# DISCUSSION—CHALLENGES FOR PAR DURING THE COVID-19 CRISIS

Our experiences in the participatory planning processes have enabled us to identify several challenges for transitioning PAR processes into an online format in the face of the COVID-19 crisis. The challenges reflect different—not only technical—capacities and capabilities to use the selected online tools (see Afzalan et al., 2017).

## Capacities for Digital Transition

An essential prerequisite for online tools to function is IT infrastructure. Cities in the Global South are more affected by extreme weather events, which, combined with fragile infrastructures, can severely affect communication (Heeks and Ospina, 2013; Birkmann et al., 2016). As the team in Lomé was highly dependent on face-to-face interactions, this, alongside the instability and quality of broadband, meant that all planning activities were forced to pause. As in Šempeter pri Gorici, not all city-team members had access to IT infrastructure, and fewer restrictions made outside meetings possible and rendered online collaboration obsolete. In all other cities, the digital infrastructure, or lack thereof, was not a limiting factor for the online process.

Moreover, the expertise and experiences with digital tools and methods varied considerably between the different city-teams. Janssen et al. (2013) suggest a new set of competencies is required to interact digitally. The case of Berlin shows the success of an online participation process being strongly dependent on the digital literacy and openness of both the participants (city-team) and the facilitator (city-team coordinator).

Even though studies show the potential of older participants in digital processes (Bergström, 2017; Reuter et al., 2021), this was not the case for Šempeter pri Gorici, with a higher average age of the city-team members who had little experience with digital formats. However, these challenges resulted in the team calling on other capacities, seen in the adoption of different ways of working according to permitted outdoor meetings that enabled their continued participation as a team.

The online tools offered were overall rated as "useful." Thus, in the sense of what function a tool can provide for a participant or an interaction, tool capacity was not the most significant challenge in our case. While a tool can serve the anticipated

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[10]Interview 26.08.2020.

functionality, it nonetheless needs to be used. However, our findings showed that different tools were used by different city-teams. The reasons for that vary from the norms and regulations of various institutions (for instance, restricting the use of specific country-based servers) to—in our case, more relevant—challenges related to technical, organizational, and community capacity and preferences.

## Capabilities for Organizational Adaption

To support a participatory process, hurdles for participants' contributions need to be minimized. However, as found in our study as well as suggested by other scholars (Janssen et al., 2013), the coordination, preparation, and support of such an online participatory process require additional workload on the administrational side. Initially, all city-team coordinators and research hubs were part of the setup of the online transition. The transfer of a face-to-face process to online, resulting in a multi-step process, demands intensive preparation in aligning the new tools and the process requirements with the stakeholders' needs and capacities. This, in all cities, proved challenging, including extensive preparatory efforts to achieve all desired outcomes.

Although COVID-19 caused a decrease in community capacity in most cities regarding the participatory process, Carthage, Sant Feliu de Llobregat, and Šempeter pri Gorici witnessed an overall increased interest in both ECS in general and its embeddedness in the communities. In Carthage, residents' attention increased regarding the potential of ECS to address urban (social) problems, for instance, urban agriculture on family-owned archeological sites of world heritage protection that support local food supply. This helps neighbors and citizens reconnect to food and offers job alternatives in economically pressing times, but it also inspires others to engage in ECS practically or in its planning. Meanwhile, in Sant Feliu de Llobregat, citizens were requesting food supply alternatives (e.g., food coops or farmers' markets) to reopen, indicating a valuing and strengthening of local alternative food networks and creating localized practical solutions to answer the global crisis. The citizens of Šempeter pri Gorici demonstrated a strong motivation to find new leisure activities increasing home gardening activities, improving mental and physical wellbeing. Even though these examples might draw city-team members away from the planning process, they strengthen the cause of ECS and its inclusion in the urban environment. A general assumption might be that the higher the share of volunteers in such a process, the more volatile its progress in times of crisis (Cameron, 2021). As described by Ejrnæs and Harrebye (2021), we witnessed that the crisis has the potential to activate and paralyze engagement. This is a phenomenon that has been studied in other times of (economic) crisis evolving from initial response to a permanent activity, for instance, in Nigeria during COVID-19 (Gbadegesin and Olajiire-Ajayi, 2020), Barcelona during the financial crisis, and post-crisis 2007-2008 (Calvet-Mir and March, 2019) or famously the cases of Detroit (Colasanti et al., 2012) and Havana (Novo and Murphy, 2000). Citizens becoming agents of change, together with the previously described increase in city administrations' attention to the COVID-19 crisis, can open a critical window of opportunity for systemic transformation of the (urban) food system while addressing interconnected social challenges (El Bilali, 2019; Zhongming et al., 2020).

## Precarity to Disruption

The city-teams, being based on the voluntary engagement of citizens, faced many challenges, as the economic and social impacts of COVID-19 led to a shift of priorities for some members, such as new responsibilities for parents to home-school, as seen in Berlin. Even though not assessed in this research, this example points out the importance of gender equality in care work and its commodification, especially in volunteerism. Care responsibilities and food provision or economic security have also shifted the focus from voluntary participation. These dynamics became most apparent in Sant Feliu de Llobregat and Lomé. Various forms of safety nets have been established in different cities to cushion the worst consequences, such as the immediately proclaimed state of emergency in Lomé. As the safety net in Lomé aimed at the poorest of society, other states introduced, for instance, short-time work, paying a percentage of the former salary. Safety nets like this benefit the higher-income earners, much less NGO employees, and not at all volunteers.

At the city-team level, many members were overworked due to the additional workload of transferring to online formats and the pressures and uncertainty of COVID-19. Following the findings of this research, it can be argued that city-teams with higher shares of staff employed through the EdiCitNet project (**Table 1**)—equaling increased support—had better chances to progress in the online process. The results support this with two exceptions—Letchworth, with the highest proportion of EdiCitNet, employed staff, withdrawing, and Šempeter pri Gorici, with a low share and one of the most advanced progresses. Nevertheless, we point out that such an online participation process in times of crisis is complex and multicausal. It can only be supported and not singularly carried by the employed city-team members. This feeds the question of which city-teams and potential members were structurally disadvantaged through relatively less support while having comparable numbers of employed city-team members but higher shares of volunteers.

To cope with this, we have seen additional professionals being employed in Berlin, Sant Feliu de Llobregat, and Carthage in the aftermath of this research to welcome new volunteers and assist the guidance of and within the city-teams. Additionally, in some cases, for example, in Berlin, many volunteers are employed in the government where staff can address EdiCitNet tasks as part of their duties. All this helped to cope with the workload, and the continuity yet raised other questions of equal representation across the community, available resources of volunteers such as time or energy to contribute to edible activities, and equal funding schemes (Submitted manuscript Edwards et al., 2018).[11]

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[11]Submitted manuscript: Edwards et al. (under revision). Terms of Engagement: Mobilizing Citizens in Edible Nature-based Solutions.

# IN CONCLUSION—LESSONS LEARNED FOR PAR FROM THE COVID-19 CRISIS

In this paper, we set out to assess the transition process of a participatory planning process to online formats, its potential, and hurdles while facing the COVID-19 pandemic. We have seen that this transition goes beyond the matter of technical infrastructure, knowledge, and skills but incorporates various social aspects, including the ones of equity and representation of stakeholders. The cases of Sant Feliu de Llobregat and Šempeter pri Gorici taught us how ECS stabilize local communities and food systems. We have seen the resourcefulness of communities in times of crisis adapting in digital ways, for instance, in Berlin and Carthage, and non-digital ones as in Šempeter pri Gorici. At the same time, the risk of overloading and losing participants underscores the importance of a flexible planning process like TPM, even more within a closed project structure.

Adapting to the changing circumstances through COVID-19, non-digital rather organizational mitigation measures (extending deadlines, increasing support, and/or splitting up tasks) proved to be the most effective requirement to continue planning with the online formats offered. These measures take pressure from vulnerable, unstable systems and their stakeholders, such as cities and their citizens, provide time to reorient and find a so-called "new normal."

Regarding the digital measures, the discussion highlights the skill-sets and capacities of the participants as one crucial consideration associated with digital equity concerns. This shows that the switch to online tools needs to consider the specific situation of the stakeholders within a participatory process and is not only a question of digital literacy or motivation. Consequently, adding to the challenge of maintaining (voluntary) stakeholder involvement, the prerequisites for digital participation (access, connectivity, and quality of time to participate) carry the risk of excluding stakeholders independent of their will to engage. Therefore, discussing who can participate in a (digital) process, under which circumstances, and including which support measures is vital in an early stage of a transition. We conclude that digital equity is relevant on many levels implying a variety of impacts on the participatory process and means—from the loss of participants to unbalanced representation(s)—and methods of participation need continuous evaluation and adaptation.

In contrast to these challenges, the examples of Carthage, Sant Feliu de Llobregat, and Šempeter pri Gorici show the mitigating potential of ECS and its potential to increase community capacity. In part, these learnings can help foster the robustness of participatory online processes, including effective communication and pioneering activities.

Reviewing the framework of Afzalan et al. (2017) indicates a lack of social indicators enabling or disabling a transition to online. In our case, it proved, to a certain extent, helpful in identifying obstacles during times of crisis, albeit only on a technical level. According to the experiences from the EdiCitNet project, we argue that such a framework can be enhanced to incorporate and anticipate the social effects of a crisis to ensure that online participatory processes are more robust and take into consideration the equity of access and participation from the outset. The skill is to see the different aspects of the framework contextualized to the local circumstances and adapted to the participants' needs, including a responsiveness to change and crisis. It is not enough to offer online tools and expect volunteers to use them as there is no one-fits-all solution. To ensure equity, access, and participation, city-team members, city-team coordinators, and researchers need to co-develop the process' frame, including the suitable modes of interaction, rhythms, and durations for their teams. Most important, however, is to support the city-team members, not only with digital infrastructure but also by tailoring interaction opportunities to their needs and capabilities and balancing the changing group dynamics that new members may bring. This overlaps with other participatory research frameworks responding to the challenges of COVID-19, such as "co-research" by Paganini and Stöber (2021), including participants in the setup, selection, and implementation of tools and modes of collaboration. Within this framework, the co-generation of the challenges, solutions, and objectives with participating teams continues the PAR ethics. Incorporating these insights creates an opportunity to improve contingency for more resilient strategies in PAR. In three out of six cities, this was demonstrated to have led to teams' adaptations to participation and strategic aims as their circumstances changed.

Within these dynamic project structures, the question of whose voices are heard is an issue of continuous reflection within the TPM, including the project team and the city-team members themselves. Organizational measures, in our case, enabled city-team members to continue as, for instance, the extension of deadlines in the light of digital equity provided time for city-team members to learn the necessary tools and get used to the new formats of interaction. The acknowledgment and funding of these necessary—sometimes time- and effort-intensive—steps to enact digital equity may, however, quickly meet the structural project boundaries. These steps are often perceived as indirectly contributing to project outcomes and easily overextending deadlines. In this research, we have seen the importance to embed digital equity along the lines of participation and ownership. To do so, it needs technical infrastructure and skills to use the tools offered and open project structures that allow for organizational adaptations, but first and foremost, it needs locally adapted support mechanisms for volunteers to facilitate and ensure equity, access, and participation.

# DATA AVAILABILITY STATEMENT

The raw data supporting the conclusions of this article will be made available by the authors, without undue reservation.

# AUTHOR CONTRIBUTIONS

MM and VF: conceptualization, methodology, validation, data curation, formal analysis, visualization, and writing—original draft preparation. MM: investigation and project administration. FE, BF, and IS: writing—review and editing. BF and FE: supervision. All authors have read and agreed to the published version of the manuscript.

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