

## THE ROLE OF DIGITAL TECHNOLOGIES IN URBAN CO-CREATION PRACTICES

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**Abstract:** *Citizen engagement in urban planning is essential to designing urban spaces that are just and responsive to societal challenges. Consequently, local stakeholders are invited into urban co-creation processes. Digital tools are often used in this process to shape urban futures together. This paper explores what role digital technologies play in urban co-creation through five case studies from European cities that were presented at a workshop during the 11th Communities and Technologies conference. The Co-Design Framework is used to analyse the cases and understand how digital tools support collaboration on different levels throughout the design cycle. The findings help to design more effective digital tools for urban co-creation and provide an analysis methodology to compare and contrast urban co-creation practices across cases varying in scale, time, and utilised tools.*

**Keywords:** *urban co-creation, digital technology, participatory planning, co-design framework, tactical urbanism, placemaking*



## INTRODUCTION

Citizen engagement in urban planning is essential for cities to design public spaces that are adequate, just, liveable, and responsive to societal challenges such as increasing population, economic challenges or climate change. Urban planning innovations are most successful when they result from a collaboration between governmental officials, citizens, and local entrepreneurs (Custers et al., 2020; Mulder, 2012). Consequently, residents and other local stakeholders are invited into urban co-creation processes, to identify challenges and co-create solutions by working with the city. Following various approaches, such as urban living labs (Mäntysalo, 2016), tactical urbanism (Lydon et al., 2015), and bottom-up innovation (Niederer & Priester, 2016), urban stakeholders collaborate on finding solutions to societal and urban planning challenges.

Previous work studied how such urban co-creation processes lead to changing roles and responsibilities of the involved actors and in what way such initiatives can be best facilitated (Leminen et al., 2012; Puerari et al., 2018; Slingerland et al., 2019). These collaborations require an innovative way of working and the creative competencies of the involved actors. Examples of such competencies are active listening, empathy, observation skills and perceptiveness, (self-)reflection, ideation, and imagining and prototyping of solutions. The facilitation of such creative collaborations requires preparation, careful facilitation, and the introduction of the right tools.

Co-creation starts with understanding the needs of the different stakeholders and reaching a shared problem definition and solution space (Sanders & Stappers, 2008; Steen, 2013). This is facilitated by various tools and methods, often based on social science research and design practice, that have extensively been studied in the fields of human-computer interaction (HCI), participatory design (PD), and interaction design. However, challenges and barriers related to inclusion, reaching consensus, and showcasing long-term impact remain to involve urban stakeholders in co-creation (van de Wetering & Groenleer, 2023; Visser et al., 2023).

Strongly driven by the COVID-19 pandemic, researchers and practitioners recently sought to address these issues by introducing digital technologies in urban co-creation (Cortés-Cediel et al., 2021). Digital technologies, in combination with analogue tools, may help to democratise urban co-creation: many residents nowadays use digital technologies, e.g. to navigate the city (Google Maps), to chat with friends (WhatsApp), and to build a (virtual) network on social media platforms. At the same time, governmental services, for example renewing an identity document, are increasingly being moved to the digital space. The number of digital services, functionalities and capabilities is growing fast and addresses all areas of life, potentially reshaping existing governing mechanisms.

Although more use of digital technologies is seen in urban planning and city services, co-creation processes and participation of citizens in development processes are still often supported through mainly analogue tools and paper-pencil techniques. This raises questions and opens up issues in digitalising such processes by harnessing the existing digital knowledge of citizens for participation and co-creation processes in urban planning and further fields of application.

This paper explores what role digital technologies play in urban co-creation through five case studies from Europe (Brussels, Munich, Rotterdam/The Hague, Vienna), Rotterdam

(Netherlands), Salzburg (Austria), The Hague (Netherlands), and Vienna (Austria). It illuminates at which stages of the design cycle digitalisation adds value to urban co-creation, and at which stages it is not supporting the process. The aim of this exploration is to untangle digitalisation in urban co-creation and to formulate propositions on when and how to apply digital technologies in urban co-creation practices.

After discussing the existing discourse on urban planning, co-creation, and digitalisation in the next section, the methods outline the five selected case studies, presented during a workshop at the 11<sup>th</sup> Communities and Technologies Conference in 2023, and how these are analysed using the Co-Design Landscape framework (Gaete Cruz et al., 2023). The five case studies are then subsequently described in the results. The discussion reflects on both how the framework helped to contrast and compare the case studies as well as when and how digitalisation supports urban co-creation and at which stage of the design cycle.

## **BACKGROUND**

The next section reviews seminal work on collaborative processes and co-creation in urban planning and considers how digitalisation has entered this domain.

### **Paradigm Shift Towards Collaborative Urban Planning**

Citizen participation in urban planning emerged in the 1960s as a critique and reaction to functionalism and comprehensive planning (Allmendinger, 2009), approaching the city as a system controlled from above by expertly prepared, ideal, large-scale master plans that were inflexible in their object orientation. In consequence, academia and professionals increasingly stressed the significance of involving citizens and communities in planning processes. Jane Jacobs and Lewis Mumford particularly emphasised the need for urban planning to embrace the intricate dynamics of city life in its architectural design. Jane Jacobs likened streets to the “lifeblood” of urban communities (Jacobs, 1961), while Kevin Lynch asserted that the physical layout of a place reflects its social fabric (Lynch, 1972). Dolores Hayden advocated for putting “places” at the core of urban landscape history (Hayden, 1988, p. 18). Urban planning shifted towards a more argumentative approach which has led to the gradual replacement of modernist comprehensive planning with incrementalist, participatory, communicative, and embodied methodologies (Healey, 1996).

Today, urban planning is reconceptualised and increasingly organised as a collaborative process. New methods and procedures are expanding or replacing established ones with informal participation methods such as neighbourhood walks, discussion forums, storytelling workshops, and pop-up events in the public space becoming part of the standard repertoire (Harris, 2002); the chronological sequence of planning processes is dissolving; new planning instruments are being introduced; and planning is partially leaving its original institutional framework, the state planning authority (Günther, 2004). Partnerships, networks and negotiations to coordinate the actors involved and their actions have gained relevance in urban planning processes. Healey introduced the concept of “stakeholding” (Healey, 1998, p. 69) as central in collaborative urban planning, recognising the diverse nature of stakes in places and calling “for the complete range of stakeholders to be acknowledged in the

process” (Harris, 2002, p. 35). In collaborative settings, stakeholders come from various sectors (public, non-profit, community, private, academia) and knowledge fields (strategic, transdisciplinary, socio-cultural) (Webb et al., 2018), with different interests, aims, knowledge and skills (Baibarac & Petrescu, 2019). Thus, places “become formed as the product of competing and collaborative groupings in space and may sustain multiple meanings and references contemporaneously” (Harris, 2002, p. 34); constituting participation as a terrain of contestation, where power dynamics continually redefine the scope of engagement (Cornwall, 2008).

The goals of collaborative urban planning are manifold (Pokharel et al., 2022). It can empower citizens (Arnstein, 1969), enable collective social learning processes (Collins & Ison, 2009), build trust (Coleman, 1988), create mutual understandings and resolve conflicts (Susskind & Ozawa, 1984), extend opportunities in public decision-making processes (Günther, 2004), contribute to solving complex issues while improving the outcomes’ legitimacy, operability, context-specificity (Baibarac & Petrescu, 2019; Gaete Cruz et al., 2021; Mulder, 2015), the development of inclusive, sustainable and just urban spaces, and ultimately a transformation in urban governance practices (Karacor, 2014).

However, collaborative urban planning and participatory practices are facing manifold challenges. Studies have identified a lack of transparency and accountability (Stokes et al., 2020), a disconnection between governments, planning authorities and communities (Foth, 2017), the exclusion of residents’ concerns and needs (Bhardwaj et al., 2021; Innes & Booher, 2004), the dismissal of citizen knowledge by planners (Buil et al., 2016), a lack of inclusiveness, representativeness, and plurality of voices (Kohon, 2018), low accessibility and a lack of interactivity (Du et al., 2020), time-consuming methods and skill requirements (Chess & Purcell, 1999); lack of trust (Bizjak et al., 2017), the challenge of complex decision-making and reaching consensus (Boukhris et al., 2016), a lack of reflection on the complexity of cities as systems (Poplin, 2014), and a persisting dominance of top-down approaches (Bizjak et al., 2017).

### **Collaborative Planning Meets Digitalisation**

The introduction of digital technologies in participatory urban planning enables new ways of communicating, collaborating and harnessing the diverse knowledge and skills of the multiple actors involved in these processes (Giannoumis & Joneja, 2022). It has the potential to facilitate the dialogue between different actors and to empower a “more communicative action-oriented process of planning and city creation” (Houghton et al., 2015). The use of digital interfaces, online platforms, location-based games or immersive environments creates different “engagement channels” (Fredericks et al., 2018) that enhance processes of local networking, exchange, discussion, community learning and action, thereby allowing for a collaborative approach with the potential of democratising urban planning (Hovik & Giannoumis, 2022; Tomitsch, 2016).

Digital technologies, with the purpose of enabling collaborative urban planning, are not developed to replace face-to-face encounters (Zurita et al., 2015) and most studies urge for a combination of analogue and digital methods (Küstermann & Bittner, 2021). As such, they are seen as a means to tackle problems in participatory processes (i.e. lack of representativeness, transparency, and needs-orientation (Chaves et al., 2021) and to

strengthen citizen participation (Buil et al., 2016), to promote public dialogue, to increase accessibility and flexibility (Zurita et al., 2015), to enable community and social network building (Bizjak et al., 2017); to enhance citizens' ability to co-create, collaborate and participate in decision-making (Khan et al., 2017), to enable playful and alternative production and exchange of multi-perspective knowledge (Poplin, 2014), and, ultimately, to improve efficiency of urban management and planning, and to increase legitimacy, acceptance and transparency in decision-making (Mata et al., 2021; Yigitcanlar, 2010). While digital technologies have a high potential to improve collaborative urban planning processes, there are several challenges: some participants may lack access to digital technology, skills, and resources (Fredericks & Foth, 2013), digital tools are often preconfigured and designed to be used in a particular way, and interaction between the participating stakeholders may be limited (Hovik & Giannoumis, 2022). Another challenge is the limited knowledge and state of the art regarding the combination of analogue and digital methods to engage the different stakeholders.

### **Using Digital Tools in Urban Co-creation**

Utilising design methods and practices for co-creation offers a promising avenue to tackle the issues outlined above and to foster collaborative urban planning. Co-creation is an iterative, reflexive, and highly dynamic approach (Itten et al., 2021). It includes “linear co-design processes and consensus building methodologies [...], but goes far beyond them, becoming a complex, articulated and often contradictory process” (Manzini & Rizzo, 2011, p. 200). Co-creation processes require shifting between envisioning and various activities, alternating between levels of specificity and abstraction (Bratteteig & Wagner, 2012).

The literature on digitally enabled co-creation provides some insights that are relevant in the context of co-creation activities with citizens. For example, digital platforms can increase citizens' intentions to take part in co-creation processes, and digital technologies can augment coproduction by enabling structural and cultural factors that act as enablers or barriers to digitally enabled coproduction (Jalonen et al., 2021). Additionally, digital technologies can support the co-creation of public value in coproduction between the government and citizens (Lember et al., 2019).

## Untangling Urban Co-creation through the Co-Design Framework

Sanders & Stappers (2008) highlight the transition from user-centred design to co-design, showing how increasingly researchers and designers engage with stakeholders in “the fuzzy front end”, the design stage where often it is not clear what the deliverable of the design process might be. Even when prototyping digital tools, often low-fidelity methods such as card games or paper and pencil are used in the early stages of the process (Baibarac & Petrescu, 2019).

The Co-Design Framework (Gaete Cruz et al., 2023) shows how collaboration may occur in different steps of the co-design process. The Framework uses a simplified ladder for the collaboration axis (vertical), drawing from Arnstein’s ladder of participation (Arnstein, 1969). Arnstein had proposed a metaphorical ladder, framing citizen participation as a question of power. Each ascending rung represents increasing levels of citizen agency, control, and power. Additionally, Arnstein views participatory power on a continuum that moves from nonparticipation (no power) to degrees of tokenism (counterfeit power) to degrees of citizen participation (actual power).

Gaete Cruz et al. (2023) remove both the bottom and the top extremities of Arnstein’s ladder. The authors also signal that they understand collaborative dynamics as “simultaneously bottom-up, top-down and peer-to-peer” (p.269), rather than strictly in a linear manner. On the Y axis, the framework maps out four stages typical in design cycles: research, analysis and synthesis, projection (or ideation), and selection (or decision-making). Thus, different levels of collaboration can be encountered in different stages of design cycles, depending on the aims and other contextual factors. The framework provides a useful way to untangle how and when collaboration may happen in urban planning, with a focus on process, and on the methods used. We, therefore, opted to use the co-design framework to map and analyse the selected case studies, aiming for a deeper understanding of their methodological similarities and the mix of digital and analogue tools.

## METHODS

The Co-Design Framework has been selected from the literature as a conceptual lens to analyse how digital tools are utilised in urban co-creation. Five different cases are the units of analysis. What follows is an explanation of how the cases were selected and analysed using the framework.

### Case Selection

The five cases analysed in this paper were originally submitted to the workshop “Co-creation practices and technologies for open urban planning” (Tellioglu et al., 2023), which took place at the 11<sup>th</sup> Communities and Technologies Conference in Lahti, Finland, in 2023. The workshop aimed to connect researchers and practitioners interested in co-creation practices, techniques, tools, and technologies for open urban planning. Specifically, the workshop drew on theoretical approaches from computer support cooperative work and from participatory design, focusing on engagement, participation and consensus-making in the context of urban

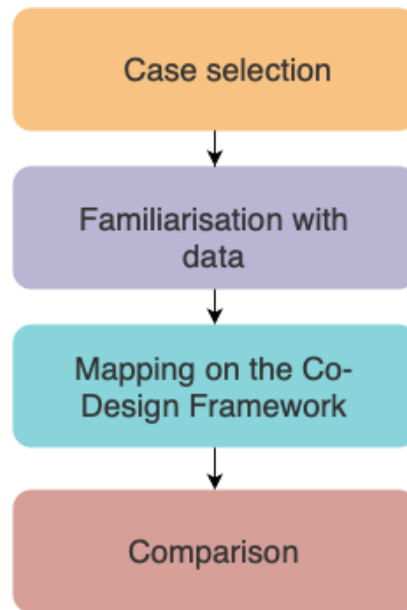
co-creation processes (Tellioglu et al., 2023). Participants were invited to submit position papers through a call for participation. Seven papers were selected for presentation in the workshop, including a scoping review on digital participation through ICT and a reflective paper on the challenges of co-creation processes in urban planning. The workshop took place in a hybrid mode, with three participants joining in remotely. The session lasted for a day and consisted of an introduction, followed by presentations of the different projects and a discussion round focusing on common challenges and approaches of the different cases. After the workshop, participants decided to systematise the common challenges and approaches in this paper. All participants worked collaboratively throughout this process. The five presented cases in the workshop, which represent projects of implementation of co-creation in urban planning that use digital technologies, were included. The other two papers (the scoping review and the reflective paper) were not part of the analysis but helped shape the background, context, and discussion of the case studies and results.

We are aware that there are many more projects which employ participatory approaches in urban contexts. Our selection of the five cases is strongly influenced by the projects submitted to the workshop. However, as in-person participation was not mandatory, this lowered the barrier to attending the workshop. The current case selection highlights diverse approaches to participatory urban planning, using different types of technologies, ranging time spans and urban scales, acknowledging the broader spectrum of ongoing projects in this field.

## Data Analysis

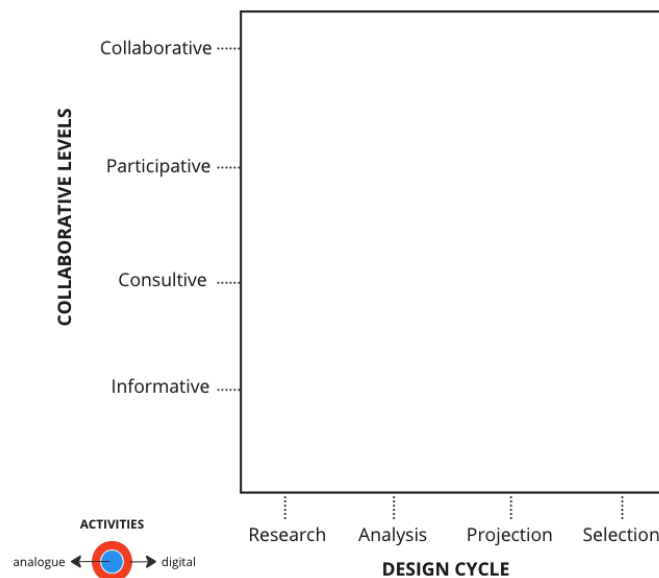
The analysis of the cases took part in *four steps*, starting with the *selection* of the cases as illustrated in Figure 1. We excluded here the two workshop papers that did not consist of empirical findings, namely the scoping review and the reflective contribution which focused on challenges in co-creation processes. Input from these, however, was incorporated as part of the discussion. In a *second step*, the researchers re-read each other's contributions, to familiarise themselves with the entire corpus of data.

*Thirdly*, we considered potential frameworks for comparing the different cases, with a focus on the process, rather than the outcomes of the projects, considering these were very different in scope and duration. We settled on the Co-Design Framework by Gaete Cruz et al. (2023), as it focuses on how collaboration may occur in different steps of the co-design process. In mapping the five cases on the Co-Design Framework, we made two additions as outlined in Figure 2. Firstly, we colour-coded the activities, to clarify to what extent participation took place in a digital or analogue manner. Therefore, in the case descriptions, the colour-coded dots illustrate the characterisation as digital or analogue activity or both, where the size of the circle represents the proportion of each (see Figure 2). Secondly, where we conducted activities across two or more design cycles, we numbered these, to clarify which activities were part of the same design cycle.



**Figure 1.** Process for the data analysis of the cases

Finally, *in a fourth step*, we compared the five cases to draw on insights resulting from the mapping of the Co-Design Framework. We simultaneously addressed to what extent the framework helps explain the cases and what are its limitations, while also looking specifically at the analogue-digital dimension, the types of stakeholders involved, and the temporality of processes and activities. These findings and reflections are illustrated in the results and discussion of the paper.



**Figure 2.** Co-design Framework by Gaete Cruz et al. (2023). The colour coding of analogue and digital activities is made by the authors.

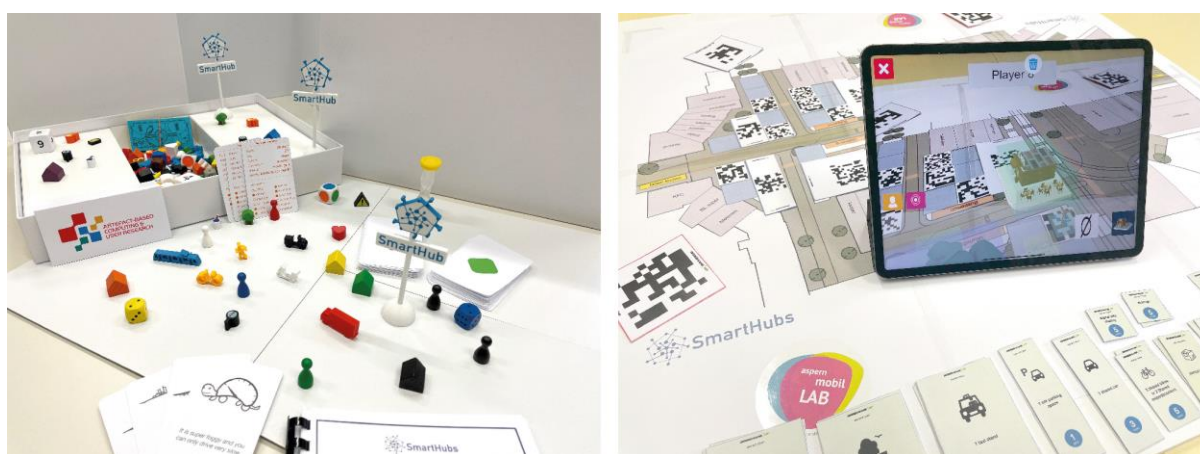


## RESULTS

Below follows a description and coding of the five cases Europe (Brussels, Munich, Rotterdam/The Hague, Vienna), Rotterdam (Netherlands), Salzburg (Austria), The Hague (Netherlands), and Vienna (Austria). All cases are contextualised through a brief case description. An overview of the activities is outlined in a table and mapped onto the Co-Design Framework. These mapping and its implications are further elaborated in the text.

### SmartHubs Design Game - Europe

In the SmartHubs project, Design Games (Brandt & Messeter, 2004) are applied to identify stakeholder requirements, characteristics and wishes for smart mobility hubs. The application of Design Games follows two iterations, starting with an analogue Design Game, which is then transformed into an augmented reality (AR) supported Design Game in the second iteration. The game can be played by up to eight players, who design a specific area around a mobility hub and arrange elements, such as shared bikes, free WIFI, information kiosks, parks, etc., on the gameboard. The elements are physically realised as cards to be placed on the analogue gameboard. For the AR Design Game, prototypical smartphone apps were developed to enable augmented reality gaming support. Therefore, on each card, a QR-code is printed that is scanned by the app and the element is displayed on the smartphone screen. Figure 3 outlines the analogue and the AR game.



**Figure 3.** Analogue Design Game package with various materials (left) and resulting AR Design Game (right).

The SmartHubs project includes four living labs across Europe where different analogue games were designed and applied. For the design phase of the analogue game, the main stakeholders were the research partners from the project who run the living labs in Brussels, Munich, Rotterdam/The Hague, and Vienna. The application of the resulting games was realised with the stakeholders of the four labs, such as citizens, planners and municipalities. Both two design cycles included multiple activities in each stage of the design cycle axis and on various collaborative levels of the Co-Design Framework (Gaete Cruz et al., 2023). All

participative research activities are presented in Table 1 and time ordered according to their application.

**Table 1.** SmartHubs Design Game case at a glance.

<b>TIME</b>	<b>Activity</b>	<b>Stakeholders</b>	<b>Analogue vs. digital</b>
Aug. 2021	Collection of living lab profiles	TU Wien, living lab partners	Digital via cloud services
March 2022	Workshop for Design Game package and guide	TU Wien, living lab partners	Digital via online meeting including tangible objects
April, May 2022	Design support meetings	TU Wien, living lab partners	Digital via online meeting including tangible objects
From May 2022	Play testing of analogue Design Games	Living lab partners and living lab stakeholders	Analogue at the living lab location
June 2022	Design evaluation meetings (analogue Design Game)	TU Wien, living lab partners	Digital via online meetings
June 2022	Workshop for AR feature definition	TU Wien + feedback from living lab partners	Analogue in-person workshop and digital online meetings
Dec. 2022	Initial AR prototype tests	TU Wien, living lab partners	Digital (AR) and analogue (tangible game materials)
From March 2023	Play testing of AR Design Game	TU Wien, living lab partners and living lab stakeholders	Digital (AR) and analogue (tangible game materials)
March 2023	Design evaluation meetings (AR Design Game)	TU Wien, living lab partners	Digital via online meetings

### Cycle 1

To get insights into the contexts of each living lab, lab profile templates were provided to be elaborated by all four living labs in the research phase of the first design cycle. In this activity, the research partners from the living labs were included on a rather consultative level. The structure of the templates was defined in collaborative project meetings together with the research partners. The resulting templates were shared digitally via cloud services and informed the Design Game process in a consultative way.

Based on the gathered information, sets with blank gaming materials were composed and sent to the living labs including a detailed step-by-step handbook, the Design Game Guide. After all packages reached the labs, a joint design workshop was conducted to introduce the materials and the guidelines to the living labs. This took place in the analysis phase of the design cycle as the living labs provided the first insights into the applicability of the package and the handbook. From the perspective of collaboration, these activities have been rather informative. The workshop was conducted digitally as an online meeting. Photos from the materials were presented on digital slides, though some research partners also used tangible objects of the package.

Further online workshops were conducted with each partner to continually support the design process. These workshops were used to assist the partners in creating Design Game

ideas, structuring the game flow and envisioning possible applications of the provided gaming materials in the package. Thus, these meetings can be classified as consultative, and they took place at the projection stage of the design cycle. The workshops were conducted digitally via online meetings, and again, tangible materials were used to present certain aspects of the game development.

From this first design cycle, one unique Design Game from each living lab resulted. The Design Games were play-tested in joint in-person meetings with all project partners and applied by the living labs with their stakeholders. This activity was conducted in the selection phase of the design cycle and is classified as participative on the collaborative level. The play testing activity was solely analogue, gathering players at one location to play the Design Games.

After the Design Games were applied, the design process of the living lab partners was evaluated in joint online evaluation meetings. Structured online meetings were conducted in the selection phase of the design cycle with all living lab partners to get insights into their design processes, the use of the provided material package and the guideline handbook. These consultative meetings clearly visualised the outcome of the analogue game design process but also informed the first phase of the second design cycle.

## Cycle 2

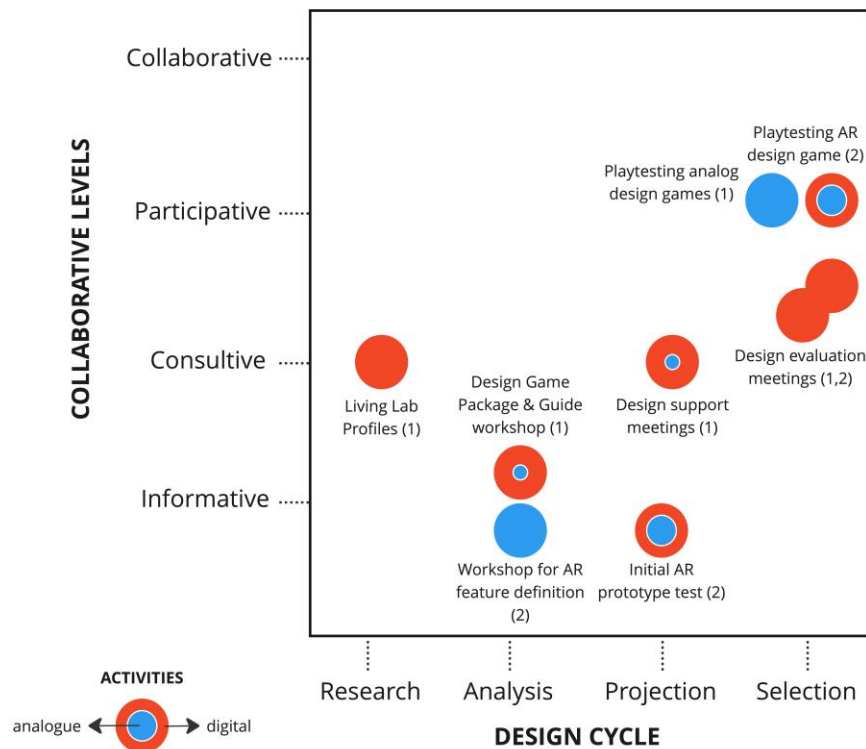
In the second design cycle, the implementation of an AR Design Game was planned, using the game principles of the analogue Design Game from the Rotterdam/The Hague Living Lab as a basis for the implementation.

An explicit research phase was not needed at the start of this design cycle as the evaluation meetings from the end of the first cycle informed the second design cycle. The most relevant features of the AR Design Game were defined in the analysis phase of this design cycle in an internal workshop at TU Wien and communicated to the living lab partners digitally via informative online meetings and documents.

During the implementation phase of the smartphone apps, internal test sessions at TU Wien were conducted and the results were discussed with the living lab partners in online project meetings. Pictures and videos of the app and its functionality were presented, and feedback was gathered from the living lab partners. This activity took place in the projection phase of the second design cycle and was informative on a collaboration level. The AR app is a digital tool, but still some analogue gaming material, as the tangible gameboard and elements cards are used.

After the release of the app, in the selection phase of the design cycle, the AR Design Game was play-tested at in-person project meetings and applied by the living lab partners together with their stakeholders in participative sessions. Due to the characteristics of the AR Design Game, the playtesting is a mixture of digital and analogue activity. The AR Design Game itself is played in person using a gameboard and other analogue materials but enhanced by the digital AR layers.

As the final activity of the second design cycle, online evaluation meetings were conducted as part of the selection phase. Living lab partners provided structured feedback from the application of the AR Design Game in participative, consultative meetings.



**Figure 4.** The co-design landscape for the SmartHubs Design Game. *Note for Figures 4, 6, 9, 11, and 17:* The colour-coded dots illustrate the characterisation as digital or analogue activity or both, while the size of the circle represents the proportion of digital and analogue parts. The numbers in the brackets refer to the design cycles.

In the development of the analogue Design Games and the AR Design Game, we managed to complete two full design cycles according to the co-design framework (Gaete Cruz et al., 2023). On the axis of collaborative levels, our activities reached the participatory level, where the games were played by the living lab partners with their stakeholders. The resulting Design Games as co-creation tools enable stakeholders such as citizens, municipalities, researchers and urban planners to meet in a common arena, debate and exchange their perspectives regarding the design of a smart mobility hub in an informal atmosphere the Design Game creates. On this level, Design Games provide valuable insights and ideas for planning future smart mobility hubs. As these stakeholders participate in playing the game, they provide their contribution, but as not all of them are included directly in the decision-making of smart mobility hubs, this activity cannot be characterised as collaborative.

## **Biodiversity Urban Living Labs - Rotterdam**

The Biodiversity Urban Living Labs (BULL) case explores ways of co-designing “smart” data platforms and tools to engage citizens in supporting efforts towards local biodiversity. Given that most of the existing biodiversity monitoring tools are designed for expert users and most city space is privately owned, the BULL approach aims to engage residents in this urban transformation. The BULL approach should not only engage citizens but also lead to opportunities for individual and collective action towards biodiversity as a perceived common. The BULL approach is developed in collaboration with several stakeholders, the most important ones include a data-driven biodiversity foundation and a neighbourhood organisation. As this is an ongoing research project, only the two first design cycles are presented here, outlined in Table 2 and Figure 6.

### **Cycle 1**

The first design cycle (for more information, see Slingerland & Overdiek (2023)) involved explorations and co-designing of various tools that support conversations with residents of a neighbourhood in Rotterdam (Netherlands) about neighbourhood green and biodiversity. This happened through pop-up activities, structured around a tea house that moved around in the neighbourhood for eight weeks at different locations. A constant reflection on the pop-up activities happened during community meetings with the main stakeholders. In the pop-up activities, multiple tools were tested, both analogue and digital ones. Therefore, this activity is mapped in multiple places on the Co-Design Framework and supports different collaborative levels with the residents who visited the teahouse. The digital tool tested was a sensor and corresponding platform which would provide suggestions on how to design your outdoor space based on the sensor’s measurements. While this digital tool did not attract the interest of residents (while it was designed to be a collaborative tool), nor help them to talk about biodiversity, the opportunity map (see Figure 5) did support residents to co-create biodiversity hotspots and start negotiating about potential actions.

### **Cycle 2**

The second design cycle aimed to create a digital prototype of this opportunity map since an analogue version requires residents to meet at a dedicated time and space and a facilitator to explain the table and structure the discussions. The first activities involved the interface design of the prototype and was created with paper sketches. Here, residents’ opinions collected from the teahouse in cycle 1 were only used to inform this research. The paper-based prototype was tested with students, researchers, and industry professionals during a workshop (around 30 participants). Now, participants were consulted for their input and this was used to decide on design principles, so the selection stage of the Co-Design Framework (Gaete Cruz et al., 2023). Based on the collected feedback, ideas for improvement were generated by the design students and presented to the main stakeholders in a community meeting. In total, four community meetings were scheduled during the two cycles, mainly on the collaborative level, because in the meetings the researchers shaped the project together with the other main stakeholders, including the local community representatives. The

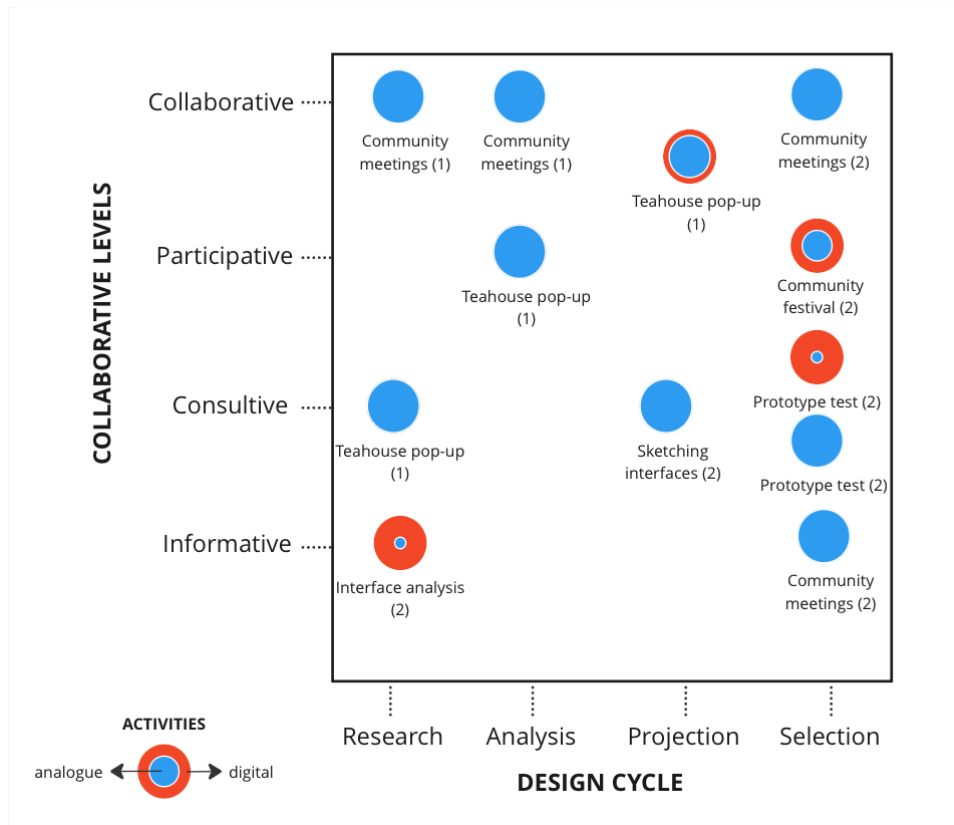
community meeting in which the platform design was discussed was on an informative level; however, input from the community is going to be collected during a neighbourhood festival scheduled in May. The organisation of the festival is mapped onto the collaborative level because this is truly a joint effort between researchers, the local community, and the other key stakeholders, as outlined in Table 2. The design was then further prototyped in a digital format using Figma software and is going to be tested during a conference in April 2024. Furthermore, a neighbourhood festival is organised in May 2024 where the digital platform to evaluate and design local biodiversity scenarios will be launched. Overall in the BULL project so far, the analysis and projection stages of the design cycle happen within the research and design team, and the participatory and collaborative activities have been executed to inform the selection stages of the design cycles. In the first cycle, though, the teahouse activities also allowed stakeholders to inform and consult the research stage of the design cycle. In that sense, the BULL activities until now follow a traditional human-centred approach, rather than a participatory one.



**Figure 5.** Opportunity map that allowed residents to co-create collective action towards more biodiverse green in the neighbourhood.

**Table 2.** Biodiversity urban living lab case at a glance.

<b>TIME</b>	<b>Activity</b>	<b>Stakeholders</b>	<b>Analogue vs. digital</b>
January 2022	Community meeting to prepare pop-up activities	Biodiversity foundation, neighbourhood organisation, researchers	Face-to-face meetings
February – May 2022	Pop-up activities, teahouse	Biodiversity foundation, researchers	In the neighbourhood, both digital and analogue tools at the teahouse
September – October 2023	Analysis of existing interfaces and platforms	Design students, researchers	Miro board and digital tools, discussions face-to-face
November – December 2023	Sketching interfaces of opportunity map	Design students, researchers	Analogue
January 2024	Prototype test	Students, researchers, industry professionals	Paper-based prototype
February 2024	Community meeting to present prototype and findings	Biodiversity foundation, neighbourhood organisation, researchers, design students	Paper-based prototype in a face-to-face meeting
April 2024 (planned)	Prototype test during conference	Students, researchers, industry professionals	Digital prototype in a face-to-face setting
February - May 2024 (planned)	Community festival, community meetings to prepare it	Biodiversity foundation, neighbourhood organisation, researchers, design students	Digital prototypes and analogue tools at a neighbourhood festival location



**Figure 6.** The co-design landscape for the BULL approach. Some activities have not happened yet and are only planned.

## Speculative Futures in Salzburg

This work took place in a business district area in the city of Salzburg, which hosts a variety of technology companies, research facilities, university buildings, housing, and student dorms. The area had been transforming, with further interest in building housing units and potential redevelopment and relocation of some facilities. Moreover, while the area is compact, it has a limited number of amenities, such as eateries or outdoor seating spaces (see Figure 7).

The co-design process was led by the research team at the Center for Human-Computer Interaction at the University of Salzburg. The respective project team was especially engaged in digitalisation and public spaces. Throughout the activities described below, the researchers involved experts (architects and urban planners), representatives of city and regional institutions, residents, employees, and visitors to envision the future of this district. This resulted in two cycles of the co-design process (see Figure 9 and Table 3):

1. Creating futuristic visions of the district, using a speculative co-design approach.
2. Co-designing an augmented reality application called City Craft to support collaborative placemaking.



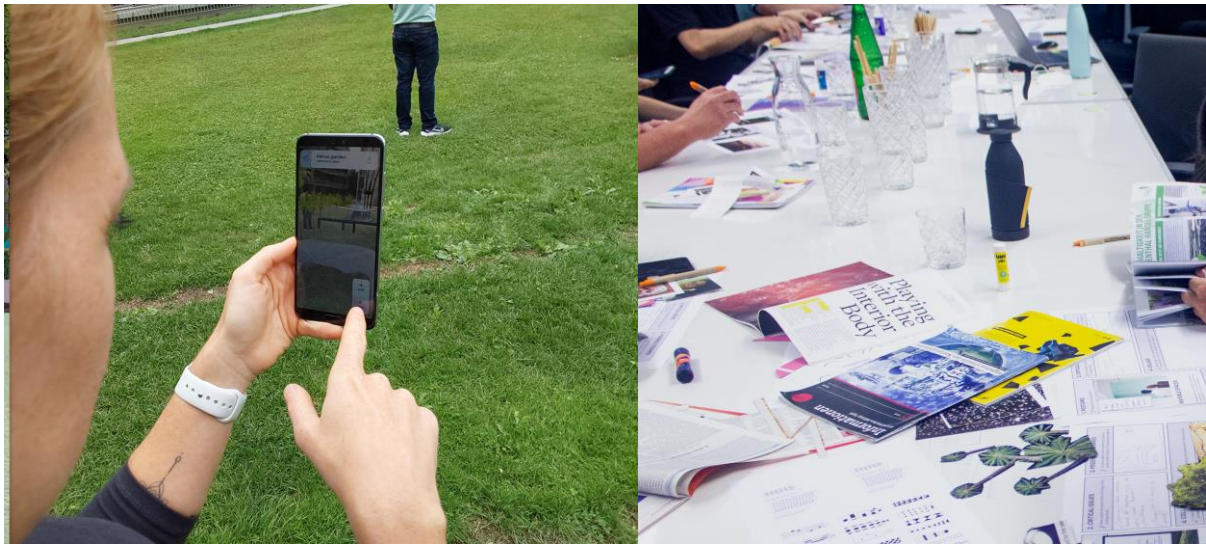


**Figure 7.** Science City Itzling, the location of the co-design activities.

## Cycle 1

The first cycle focused on building futuristic visions of the district, starting from, and including technological developments researched in the facilities present in the neighbourhood. This process was mostly analogue, as it resulted in fiction created in the format of “Postcards from the Future.” We opted for interviews with experts in the research and analysis phase, which focused on technologies relevant to the future of the built environment. Some interviews were digital, and some were analogue, depending on the location and time availability of experts. They directly informed the contents of the proposed fiction, as the results of interviews were analysed through affinity diagrams and were then translated into ideas for fictional postcards through ideation (Paraschivoiu et al., 2023).

We opted for pre-curating the fiction in the Projection phase, as some of the topics required an understanding of the underlying technology. The fictions were then used in two types of collaborative activities with a variety of participants: students, researchers, employees, visitors, and others. Participants took part in pop-up events and workshops, where they used the curated fictions as prompts to express their thoughts on a variety of topics such as the relationship between built environment, technology, and nature, or their hopes and fears about digitalisation in cities (Paraschivoiu et al., 2023).



**Figure 8.** Co-designing with the augmented reality app (left) and speculative design workshop using analogue tools (right).

## Cycle 2

In the second cycle, we addressed more specifically the topic of urban design and what kind of changes the community envisioned for it. To this end, we started the research and analysis phase with ten more interviews, with employees, residents, students, and experts. We specifically wanted to understand their cognitive mapping of the area, including their perception related to amenities, mobility, and urban furniture. This cycle included a more mixed approach to use of analogue and digital tools throughout the different activities.

The interviews again took place both in person as well as digitally, depending on the availability of interviewees. In addition to questions related to the site, we collected insights regarding the potential use of an augmented reality (AR) application, which resulted in an initial list of features and requirements. In the Projection phase, we involved 28 students in conducting ethnographic observations, noting down how the public space was used. The students then created 14 storyboards, illustrating their ideas for changes in public space and how these might be addressed through collaborative urban design.

The students themselves had freedom in how to collect their impressions and create their storyboards, resulting in some of them opting for hand drawings and sketches, while others used digital tools like Storyboarder.

These insights were further used to create a demo of the City Craft app, which was used in the first workshop. Citizens tested a version of the application with limited functionality, where they could place objects in public space and visualise and edit them. The interface had minimal onboarding, and testers offered input on interaction, user experience and design with City Craft. A click-prototype was also created. This was tested in single sessions in a walkthrough format, where researchers discussed with participants the application and its use in public space, following each functionality or step. Finally, we engaged 33 participants in workshops where they were invited to collaboratively design the urban space with augmented

reality. They could visualise and edit each other's designs and they also discussed their choices and which suggestions could be prioritised for implementation. The sessions concluded with a debrief discussion on the potential of AR for urban design and on their motivation to participate in participation processes related to the city.

**Table 3.** Speculative Futures in Salzburg case at a glance.

<b>TIME</b>	<b>Activity</b>	<b>Stakeholders</b>	<b>Analogue vs. digital</b>
September – October 2021	Expert interviews	HCI Salzburg, experts	Digital via online meetings and in person
December 2021	Ideation	HCI Salzburg	In person (analogue)
April – July 2022	Pop-up design fiction	HCI Salzburg, residents, employees, students, visitors	In person at different locations
July-September 2022	Design fiction workshops	HCI Salzburg, residents, employees, students, visitors	In person, workshop space at HCI Salzburg
March 2022	Interviews	HCI Salzburg, residents, employees, students, experts	Digital via online meetings and in person
April – May 2022	Storyboarding	HCI Salzburg, students	Sketching (analogue) or digital (different tools)
June 2022	Demo workshop	HCI Salzburg, researchers, digital experts	In person, using the AR app collaboratively on site
October – November 2022	Click prototype walkthroughs	HCI Salzburg, residents, employees, students	In person, using the click-through prototype, on site
April – September 2023	City Craft workshops	HCI Salzburg, employees, residents, students, architects, urban planners, city officials	In person, using the AR app collaboratively on site

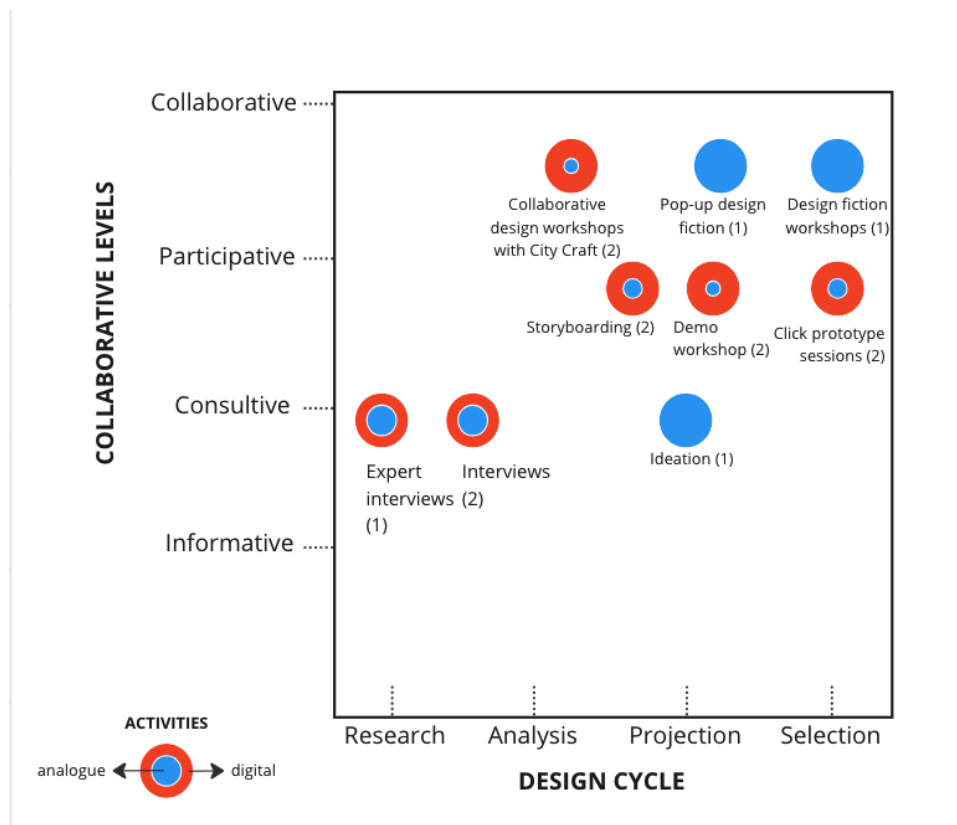


Figure 9. The co-design landscape for the Speculative Futures in Salzburg.

### Location-based Game for Place-making – The Hague/Rotterdam

Location-based games are games that use technology to situate players in their location. The location to play the game is, therefore, a vital part of the gameplay. The location-based game *Secrets of the South* was developed in several cycles of which two are described here. The game is played with challenges, which are available depending on your location, and invite players to engage with the environment. The first cycle focused on evaluating challenge categories and the second on co-designing challenges. These two cycles took place over a period of two years (2018-2019). The activities are outlined in Table 4 and mapped onto the Co-Design Framework in Figure 11.

#### Cycle 1

The location-based game is an augmented-reality game and is played on a mobile phone. The first design cycle (for more detailed description, see Slingerland, Lukosch, & Brazier (2020)) took place in a neighbourhood in Rotterdam and involved children between 10-12 years old. Other stakeholders were a primary school and two local organisations. With these, two stakeholder meetings were held to manage expectations and exchange knowledge about the neighbourhood. To prepare the co-design workshops and playtests, the research team went on a neighbourhood walk with a local actor to get to know the area (informative level) and met with the school director and expertise actors to discuss what would work (and not) in terms of

co-design with children. These stakeholder meetings were on the collaborative level because a long-term collaboration was envisioned, and joint decisions were made on the scope of the research. The aim of this cycle was to co-create content for the game (the challenges). As a result, almost 50 challenges were designed by the children during the workshops (Slingerland, Lukosch, et al., 2020).

The design workshop and playtest happened during schooltime. Children went out in groups in the neighbourhood surrounding the school and were accompanied by researchers, who observed the children doing co-design and facilitated when necessary (see Figure 10). The children were debriefed at the end of the workshop. Mostly paper-based materials were used in the workshop, including an analogue camera. Mobile phones were used by children to interview each other and other residents. The challenge design workshop is mapped on the participative level, because the children were in the lead to design the challenges. In the design process, this activity informed the Projection stage, where idea generation takes place.



**Figure 10.** Children working on their challenge designs while walking around in the neighbourhood, supported by paper-based materials.

## Cycle 2

The second design cycle (for a more detailed description, see Slingerland, Fonseca, et al. (2020)) took place in a neighbourhood in The Hague (Netherlands). Based on the challenges designed in the first cycle, researchers designed five challenge categories and corresponding challenges in preparation for the playtest workshop. This was a participative collaboration between the researchers only. In the workshop, residents of the neighbourhood played the game and were asked to evaluate the challenges and, specifically, the categories. This was a consultative activity to select the most engaging challenges. Here, digital technology (games on the mobile phone) was combined with analogue materials (the urban environment). In the follow-up workshop, residents designed their own challenges on paper and hence no digital technology was involved. During this workshop residents discussed their current experience of places with each other and envisioned what these places could or should be in the future

(Slingerland, Fonseca, et al., 2020). These two workshops deliberately mixed up the projection and selection stages of the design cycle, as it was assumed residents would design richer challenges after having played experience with the game.

**Table 4.** Location-based game for place-making case at a glance.

<b>TIME</b>	<b>Activity</b>	<b>Stakeholders</b>	<b>Analogue vs. digital</b>
November 2018	Neighbourhood walk	Neighbourhood organisation, researchers TU Delft	Walking is analogue, but shooting pictures and short videos
November 2018	Stakeholder meeting	Primary school, researchers TU Delft	Face-to-face meeting
November 2018	Stakeholder meeting	Field work organisation, researchers TU Delft	Face-to-face meeting
December 2018	Design workshops	Primary school, neighbourhood organisation, researchers TU Delft	Walking through neighbourhood with paper-based design prompts
December 2018	Challenge designs	Researchers TU Delft	Initial designs on paper, then programmed into the LBG
January 2019	Workshop 1 play testing	Researchers TU Delft, residents, community center	Playing LBG on mobile phone, situated in neighbourhood
January 2019	Workshop 2 challenge co-design	Researchers TU Delft, residents, community center	Paper, pens, sticky notes to design challenges

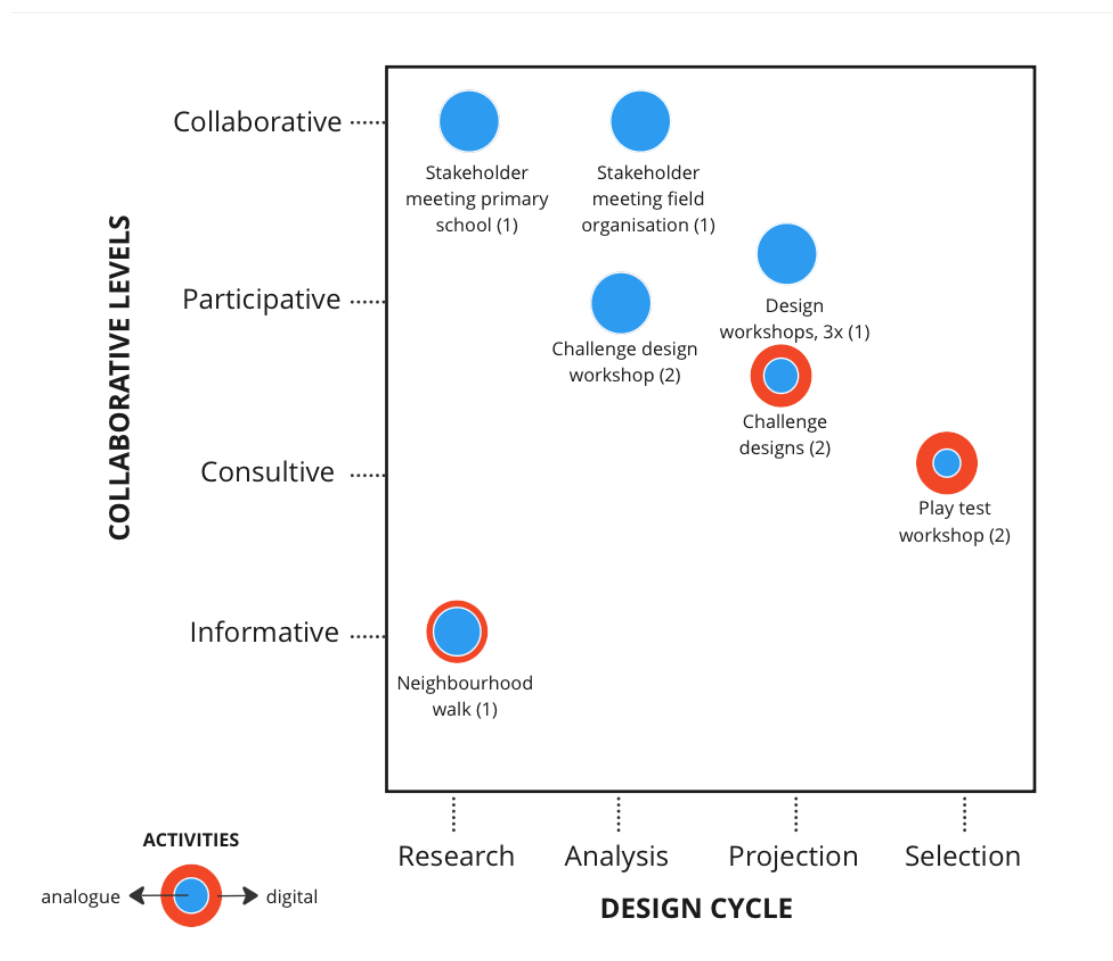


Figure 11. The co-design landscape for the location-based game for place-making.

### The Co-Creation of a “Residential Street Culture” - Vienna

The following case study examines the co-creation of a “Residential Street Culture” (German: “Wohnstraßenkultur”) – the legal use of residential streets by people. Since 2018, the Vienna culture and research organisation “space and place”<sup>1</sup> has been developing this specific street culture in Vienna in order to co-create new democratic and consumption-free social spaces in cities for all mobility participants – especially pedestrians. The project builds on the situation that consumption-free public spaces for people in cities are scarce. As stated in a recent article (Vettori, 2022), more and more green spaces in towns are being sealed, and many open spaces are being built. Social life on one's own doorstep has been displaced by the long-standing orientation of urban planning to the car-oriented paradigm (Knoflacher, 2013; Pfaffenbichler et al., 2018).

In 2018, “space and place” counted 179 residential streets in Vienna and decided to research the legal grey area of these streets in order to open up the public space “residential

<sup>1</sup> space and place, see <https://spaceandplace.at/> (Retrieved at 03/03/2024).

streets” to people. In 2022, “space and place” already counted 225 residential streets in Vienna, which indicates a steady increase in this public space.

In this paper six design cycles (2018-2023) of this ongoing project are mentioned, each corresponding to an open-air season from around May to October in which activities were carried out. Not all activities can be described. Therefore, Table 5 contains brief information on the most relevant tools and is mapped on the Co-Design Framework in Figure 17.

### Cycle 1 (2018): Use of Mainly Analogue Tools

In Austria it is not exactly regulated what non-motorised road users are allowed to do on residential streets.<sup>2</sup> They definitely are allowed to enter the residential street and play there. Cyclists may cycle in both directions. Motorised road users may enter and leave at 5 km/h, but not drive through. “space and place” in 2018 started with Participatory Observations<sup>3</sup> during walks on residential streets. It became clear that since the introduction of the Dutch concept of the Woonerf (Guttenberg, 1981; Kraay, 1986) as Wohnstraße in Austria in 1983, the concept had been conceived as a means of traffic calming but not as a place where pedestrians have priority by law: People did not walk or play on residential streets. The streets also were not safe: cars drove through; many of them faster than in walking speed. The police barely fined car drivers. Long learned behaviour led pedestrians to a uniform use of various streets: Most people walked on sidewalks even though it is allowed to walk in the middle of these streets.



**Figure 12.** The residential street “Zinckgasse” in Vienna is mainly used by drivers. Photo: Heidi Pein (2018)

In the first year of the activation of the Vienna residential street in 2018, “space and place” collaborated with the initiatives “Kollektiv Raumstation” and “geht-doch.wien” in order to examine the legal grey area of these streets and to develop the analogue tool “#residentialstreetlife” (German: “#wohnstrassenleben”): Furniture was put in parking spaces, residents and passers-by had the opportunity to make themselves comfortable: People sat on

<sup>2</sup> Cf.: Federal Chancellery of Austria (Bundeskanzleramt Österreich). Road traffic regulations § 76b (1960)

<sup>3</sup> The social anthropological method of "Participant Observation" is a field research method in which observers take on a social role in the target group under study and participate in their activities in order to document and subsequently evaluate what they perceive (Beer, 1999, p. 45).



deckchairs, stuck their feet in paddling pools, played chess or built furniture for the residential street. As a result, in September “space and place” declared the first “Day of the Residential Street” to celebrate this new “Residential Street Culture”. While the activities on that day were carried out in consultation with the police, there was no need for preceding authorisation. It became clear that everyone was able to use the residential street spontaneously on a daily basis.



Figure 13. & 14. 1<sup>st</sup> “Day of the Residential Street” in the “Pelzgasse”. Photo: Heidi Pein, 2018

The tests were evaluated and also discussed at a scientific conference.<sup>4</sup> “space and place” stated that the “Residential Street Culture” can only take off when at least four factors of the present situation would be improved: first, people need to be informed about what is allowed on residential streets; second, there need to be more safety on residential streets; third, residential streets could function as “oases of wellbeing” if the design of these streets would be improved and seating furniture would be placed there; and fourth, the “Residential Street Culture” needs to be popularised.

Already in 2018, the factor “information” was enhanced, when flyers and alternative residential street signs were placed on streets during #residentialstreetlives (“welcome on the residential street”, “always nice and slow”, “bring coffee”...) to draw attention to the residential street rules and to promote the new street culture. Also, an information film<sup>5</sup> was produced.

### Cycle 2-6 (2019-2023): Use of a Mix of Analogue and Digital Tools

In the subsequent months, “space and place” further developed the tool #residentialstreetlife in co-creation with artists, architects, residents, and holders of small local businesses or institutions like schools. Together with “space and place”, people held a picnic on “their” residential street, they read a book, visited cloths swapping and jam sessions. But they did not bring their own chair to set up a #residentialstreetlife on their own - without the presence of initiators. In 2019, to achieve more awareness for the cause, “space and place” introduced further digital tools: In cooperation with Juan Carlos Carvajal Bermúdez from the Austrian

<sup>4</sup> Paper presentation at the Vanda-Conference in Vienna in 2018.

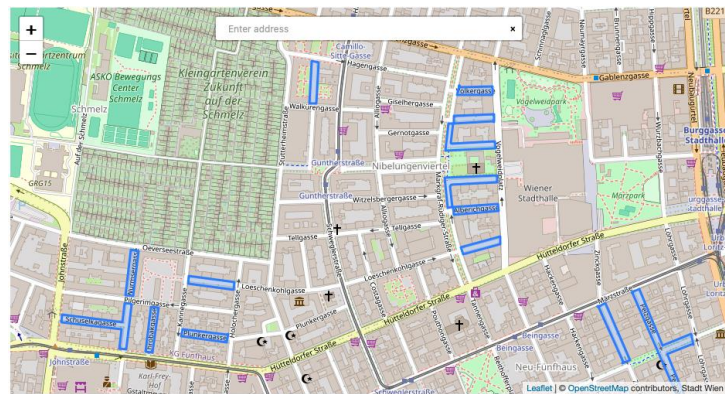
<sup>5</sup> “WIEN LEBT auf der Wohnstraße”, space and place 2018.

Institute of Technology “space and place” developed an online “Residential Street Map”<sup>6</sup> for Vienna, which was implemented on their website and shows the locations of these 225 streets. And they created a “Residential Street Quiz”<sup>7</sup>, where people can find out what is allowed on a residential street (Carvajal Bermúdez & König, 2021). Furthermore, the analogue tool “art.interview”<sup>8</sup> was developed, and the first cooperation partner (WiiR) organised a sports program on the residential street “Diepoldplatz” in the absence of “space and place”.

In the outdoor season of 2020, because of the Corona pandemic, personal meetings were only possible to a very limited extent. “space and place” produced short social media videos showing how to use the residential street by oneself. The organisation also dedicated its work towards the factors “safety & place design”: Two residential streets were painted with flowers. In cooperation with the program “Cool Streets” (Wien zu Fuß, 2020), the street was closed for three months; seating and tables were installed. Because the seatings were outdoors, they could be used by all age groups even during the Corona pandemic.



**Figure 15.** Street painting by Julia Scharinger-Schöttel / space and place  
Photo: Reinhard Gössel (2020)



**Figure 16.** Residential Street Map,  
See: [spaceandplace.at/wohnstrassenkarte](https://spaceandplace.at/wohnstrassenkarte)

In this very neighbourhood “space and place” 2020 also proclaimed the “First Viennese Residential Street Neighbourhood”, which consists of seven adjoining residential streets in the area called “Nibelungenviertel” – understood as a new type of “Superblock”. The centre was decorated for the first time with the temporary art installation “umbrella blossoms” by the architect Alain Tisserand. Neighbours and cooperation partners from “space and place” organised ten #residenitalstreelives there without “space and place” being directly involved. In another neighbourhood independent activities took place, too: the primary school

<sup>6</sup> See: <https://spaceandplace.at/wohnstrassenkarte> (Retrieved 03/03/2024).

<sup>7</sup> See: <https://spaceandplace.at/wohnstrassen-quiz/> (Retrieved 03/03/2024).

<sup>8</sup> The tool from Julia Scharinger-Schöttel was presented on a residential street in Vienna in 2019 and - together with a paper on the topic (Brigitte Vettori) at the Institute of Politics in Bordeaux at the Interdisciplinary Symposium „*Well-Being in the North and South: Explorations, Contradictions, Power, and Practices*”.

“Gaullachergasse” declared the residential street in front of their school as a schoolyard for pupils. “space and place” had been celebrating a #residentialstreetlive there in 2018 and the school built creatively on these first experiences during the Corona period. Because of these experiences “space and place” continued to pass on their expertise of how to do #residentialstreetlives also in outdoor workshops on residential streets. In 2021 – as the “Competence Centre for the Residential Street Culture” – the organisation also launched online-coaching to increase participation in the annual “Day of the Residential Street”: As a result, up to 16 residential streets were activated on such a day independently from “space and place” by various actors in Vienna and Graz. At the same time, “space and place” also coordinated activities on three more residential streets in Vienna on that day.

In 2021 “space and place” continued to develop new analogue (city/tact) and digital (QR-walk) tools and – together with other stakeholders – set up an online and offline petition for this very neighbourhood “Nibelungenviertel”, before in 2023 first improvements were realised. In 2023 “space and place” also got funded for the international EU-research project “StreetForum” which deals with the co-creation of analogue and digital tools for consensus-making in urban street transformation processes. Among other tools, the transferability of the tool #residentialstreetlife will be tested in Istanbul and Stockholm in 2024.

**Table 5.** The Co-Creation of a “Residential Street Culture” at a glance

<b>TIME</b>	<b>Activity</b>	<b>Stakeholders</b>	<b>Analogue vs. digital</b>
2018-2023	Participant Observation (cycle 1-6)	the researcher & the researched (drivers, pedestrians, cyclists)	anthropological analogue research method for self-reflexion
2018-2023	#residentialstreetlife (cycle 1-6)	residents; neighbours, holders of small businesses, institutions like schools, churches, kindergartens; co-operation partners like artists, architects, culture groups, activists; visitors; all people interested in the activation of residential streets; people from all ages, genders and backgrounds	analogue tool that can be combined with other analogue and digital tools
2018-2023	flyers (cycle 1-6)	drivers; residents; neighbours, people working on or near residential streets	friendly analogue information about the rules and regulations on residential streets & invitation to celebrate the residential street; other flyers with information on the topic or the programming of activities
2018-2023	alternative residential street signs (cycle 1-6)	drivers; residents; neighbours; people working on or near residential streets	analogue signs to be placed on easels in residential streets in order to draw attention to the street and to inform about rules and regulations & possible activities
2018	short film (cycle 1)	outdoor cinema-visitors	short film about the possible future use of residential streets
2018-2023	ideation and evaluation meetings	team "space and place"; cooperation partners; representatives of the City	analogue activity, also carried out digitally to a certain extent

	(cycle 1-6)	of Vienna; individual residents	
2018-2023	discussions with stakeholders (cycle 1-6)	residents; local experts; participants in discussions	analogue activity, with restrictions also possible in digital communication channels
2018-2023	scientific conferences (cycle 1,2,3,6)	scientists and experts	analogue activity, in exceptional cases online
2018-2023	PR (cycle 1-6)	local & national media and its readers	digital information about the #residentialstreetlife tool and the co-creation of a "Residential Street Culture"; analogue interviews
2019-2023	Residential Street Quiz (cycle 2-6)	anyone who wants to know more about the legal use of residential streets, including district councillors and other representatives of the city	digital tool, also used in analogue meetings or #residentialstreetlives
2019-2023	Residential Street Map (cycle 2-6)	all people from Vienna who want to use a residential street	digital tool to help find residential streets in Vienna
2019	art.interview (cycle 2)	residents & people who want to share visions for the future of the residential street	analogue tool; images can also be used digitally in presentations
2020	short videos on social media (cycle 3)	people interested in the use of residential streets during the Corona pandemic	digital tool to foster the analogue "Residential Street Culture"
2020	street painting (cycle 3)	financial partners supporting the authorisation of street painting; partners such as district heads and various departments of the City of Vienna; artists; residents; neighbours; visitors	analogue street activity: paint a street with a semi-permanent paint which lasts for several years.
2020-2023	umbrella blossoms (cycle 3-6)	all residents; neighbours; visitors of a place where the temporary art installation takes place	analogue tool made of (recycled) umbrellas to raise awareness for a place or street
2020-2023	workshop "Making of #residentialstreetlife" (cycle 3-6)	interested residents; multipliers from art and culture or city-related organisations; students from various universities in Austria and abroad	analogue tool to learn hands on how to organise a #residentialstreetlife; also carried out as a walk
2020-2023	online coaching for the organisation of the annual "Day of the Residential Street" (cycle 3-6)	interested residents in Vienna and other cities; local organisations or holder of small businesses who want to implement a #residentialstreetlife on the Day of the Residential Street	digital tool; two to three preparation meetings before & one evaluation meeting after the activity, which is realised independent of "space and place"
2021-2022	QR-Walk in the "First Viennese Residential Street Neighbourhood" (cycle 4-5)	anyone interested in visiting this neighbourhood; especially people living in the area and passers-by	digital tool that informs about the history of this "Residential Street Neighbourhood" and interesting people living or working here; about activities which can be done on residential streets
2021-2022	city tact (cycle 4-5)	musicians, residents, neighbours, passers-by, people interested in art & culture	music rehearsals (in contrast to notifiable concerts) on a residential street

2022-2023	petition for a better quality of life in the “First Vienna Residential Street Neighbourhood Nibelungenviertel” (cycle 5-6)	residents & other people who are interested in the neighbourhood or the promotion of the “Residential Street Culture” and want to sign a petition	analogue and digital vote collection; information dissemination through flyers, online information, hearings in the petition committee and the respective district
2023	various consensus-making tools (cycle 6)	people & neighbours involved in two specific living labs in Vienna and residential streets as part of the interdisciplinary EU research project StreetForum (residents, pupils, community gardeners, holder of small businesses or cafés, city representatives, district councillors)	analogue tools which foster consensus making between different stakeholders in the project area; will be combined with digital tools in 2024/2025

All these tools and activities, as well as the ongoing research and networking, have been contributing to progressing and diversifying the culture of residential street life. Because of public relations and social media work, the topic also gained popularity in the local and national media.<sup>9</sup> The analysis of this case study shows that the analogue tool #residentialstreetlife, which can be seen as rooted in the field of “tactical urbanism” (Lydon et al., 2015), is the most central to raising awareness for the “residential street culture” and to foster a common understanding of the manifold possibilities of using these streets as a social public space. “space and place” used the tool nearly 80 times from 2018-2023, and other residents and cooperation partners have started to organise #residentialstreetlives on their own.<sup>10</sup>

The Co-Design Framework below, which is extended to the “collaboration level” with the category “self-determined”, shows that, in general, analogue tools dominate at the “participatory” and “collaborative level”, while groups of mixed approaches can be identified at the “informative” and “consultive level”. It becomes clear that analogue and digital tools support each other in a design circle from “research” to “selection” - or as put in the Figure from “research” to “implementation & evaluation”. The tool #residentialstreetlife is especially being supported by digital tools such as the “residential street map” or the “online workshops”. Because in Austria, residential streets can be used spontaneously without any further permission, it is possible to reach the highest level of participation in the activation of the residential street – namely, the “self-determination” of the users (Bliss, 2009)<sup>11</sup>. This is why residential streets can be described as consumption-free, democratic social places in the city that residents may create for themselves.

<sup>9</sup> See: <https://www.spaceandplace.at/presse> (Retrieved 03/03/2024)

<sup>10</sup> See.: Initiative “Goldschlag 33” (<https://www.goldschlag33.wien/>, retrieved 03/03/2024), “Wohnstraße Kollmayergasse” (<https://wohnstrasse-kollmayergasse.at/>, retrieved 03/03/2024) and “geht-doch.wien” (<https://geht-doch.wien>, retrieved 03/03/2024)

<sup>11</sup> Frank Bliss (2009) has explained the “stages of participation” in connection with participatory measures in development planning. They are also relevant in urban work and research.

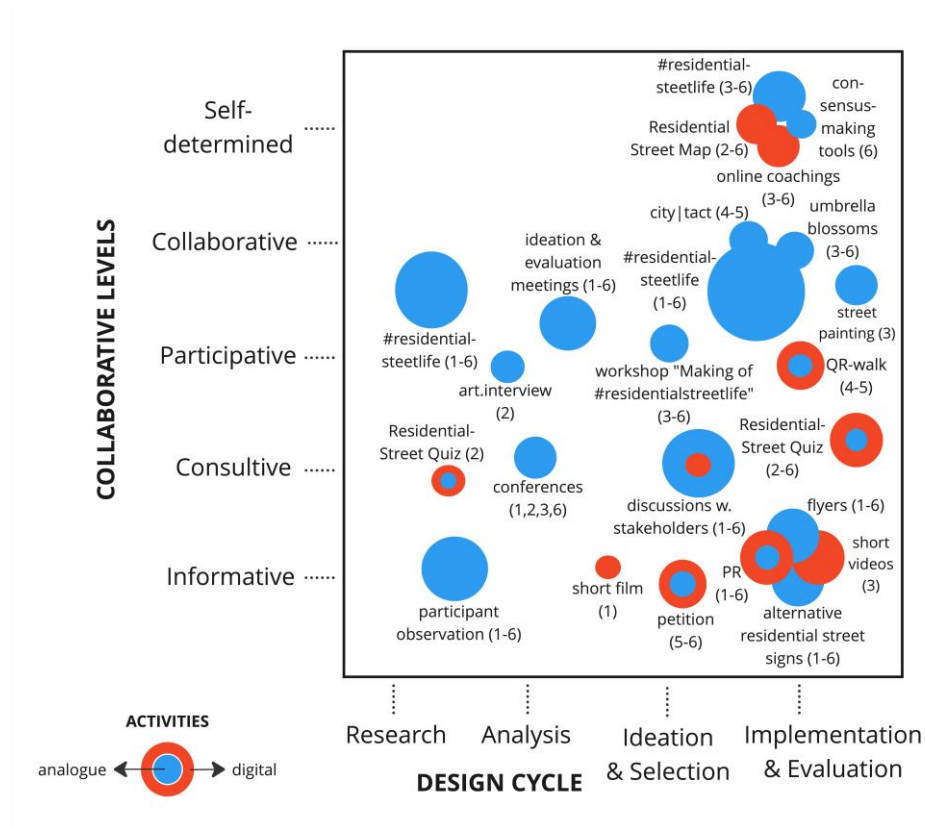


Figure 17. The co-design landscape for the Co-Creation of a “Residential Street Culture”.

## DISCUSSION

Five different types of urban co-creation were analysed in this paper using an adapted version of the Co-Design Framework (Gaete Cruz et al., 2023). The first purpose was to use the framework to untangle and articulate how digital and non-digital practices co-exist and coincide in urban co-creation practices. The second aim was to see whether this framework is useful for comparing co-design case studies that are hugely varied in timespan, spatial scale, stakeholder involvement, and number of collaborative activities. This section will discuss when and how digitalisation occurs in the design cycle of urban co-creation processes (purpose 1) and which insights can be gathered by comparing our cases through the Co-Design Framework (purpose 2).

## **The Role of Digital Technology in Urban Co-creation**

All five presented cases of urban co-creation use digital technology through all the stages of the design cycle. However, the number of activities that include digital elements varies amongst the cases, ranging from the “Co-Creation of a Residential Street Culture” case initially using a lot of analogue-based activities, to the SmartHubs case using digital technology right from the start. It is, however, questionable whether introducing technology early in urban co-creation is the most suitable approach. Not only are designers and researchers used to designing, organising and applying analogue packages and tools (such as cultural probes (Mattelmäki, 2008)), but participation is always about getting in contact with other people (Baibarac & Petrescu, 2019; Webb et al., 2018). Transforming this process and tools into digital services affords high effort, knowledge and testing to achieve a certain quality in the results. Why transform well-working analogue methods and tools into digital versions? The experiences in four of the cases (Smarthubs, Speculative Futures, Place-making game, BULL) illustrated that digital technology in urban co-creation can distract from the collaborative process because the technology is buggy and users are unfamiliar with it. This resonates with findings from others (Vrebos et al., 2023) who have experimented with using digital technology in urban co-creation.

According to Harris (2002) (see also (Baibarac & Petrescu, 2019; Pokharel et al., 2022)), collaborative and participatory processes are complex. At the start, time needs to be invested to get acquainted, build trust, and align expectations of the collaboration (Innes & Booher, 2004). Such a process can be facilitated by technology, as the cases in this paper have shown, but it needs to run smoothly. Analogue methods appear to be easily applicable and used by participants because the majority are familiar with simple tools like paper and pencil, diaries and even photo cameras. However, participant’s experiences with digital tools can be way more varied, because people use a great variety of apps, services and devices. Someone who is familiar with an Android phone perhaps cannot easily switch to an iOS device and vice versa. People are familiar with social media, e-mail applications, calendars, note-taking apps, etc., they are using on a regular basis, and not everyone is using the same tools. This makes it difficult for researchers and designers to develop digital methods everyone can work with easily without putting unrealistic effort into it. In contrast, the case of the “Co-Creation of a Residential Street Culture” had a more incremental approach to introducing technology into the collaborative process, and, for a great part, used existing tools and platforms that residents are already familiar with. This provides more support for participants to start initiating and continuing urban co-creation activities because they are not dependent on buggy technology developed by the researchers.

Does this discussion then lead to the proposition to stop developing digital technologies for urban co-creation? Alternatively, we suggest that more is to be learned on how urban co-creation technologies should be designed to better facilitate the various stages of the design cycle. Consequently, the next two sections look more deeply into the design cycle stages of the Co-Design Framework and how digital technologies can support collaboration throughout the design process.

### **Required quality of material in design cycle stages**

The Co-Design Framework distinguishes four stages of the design cycle: research, analysis, projection, and selection. Each stage may require different kinds of facilitation, whether through analogue or digital tools. None of the presented cases uses only digital tools in the first stages; they always seem to start with analogue or at least a mix of digital and analogue. Our analysis suggests that using only digital tools hinders getting participants or communities onboard of the urban co-creation.

The Design Game, using AR, developed in the SmartHubs case completed two full design cycles according to the Co-Design Framework. In each design cycle stage, digital tools were used, sometimes together with analogue ones. Two perspectives are relevant to discuss about this case. The first perspective addresses the design process of the Design Games themselves. Here, digital tools such as online meetings and cloud services are highly supporting the process. Since the COVID-19 pandemic, people have used these tools, and collaboration through digital tools in the project worked well. The second perspective addresses the Design Game as a co-creation tool. Here, the process showed that designing and realising analogue high-quality material, such as the gaming material package, needs much effort, but digital material affords extensive work and effort to reach a level of quality where users can easily handle the material. Analogue gaming material can easily be adapted or recreated, whereas adapting the functionality of an app requires expert knowledge in software development. However, when the analogue game was being augmented with AR, the activities merely took place on an informative and consultative collaboration level. It seems that the increased digitalisation of the AR Design Game is providing a more rigid and less collaborative approach to urban co-creation. The digital version of the game is excellent to collect input, inform residents, and gather feedback, but less so for creative exploration, idea generation, and including residents in urban decision-making.

AR and other types of digital technologies can help stakeholders explore alternative perspectives to the city, which could support greatly the research and analysis stages of the design cycle, as illustrated in the Salzburg, BULL Rotterdam, and SmartHubs Europe cases. However, the cases in this paper that used AR, as well as others, noted that participants spend a great degree of effort getting accustomed to and configuring the technology (Wilson et al., 2019). Developed technology, especially those still in a prototype stage, may lack usability and most stakeholders are not lenient with prototypes. As a result, participants get distracted by figuring out how the technology can be used instead of focusing on discussing the issue at hand. This was also observed in the location-based game case, when playing the game with adults in The Hague. Particularly, in the analysis and selection stages of the design cycle that include decision-making, such type of distracting interactions are not helpful. However, as digital tools reach final stages of implementation and provide flawless user experience, they can support participants' creativity and even foster a collaborative mindset. For example, in the final workshops using the City Craft app in Salzburg, we found that most participants worked together in a collaborative way and reported an increased interest in participating in urban design, after the workshops.

In sum, (digital) tools to support urban co-creation can be varied according to which stage of the design cycle they are used. In the initial stages, or perhaps in the whole first iteration, when stakeholders are building trust and starting up the collaboration, digital co-creation tools are perhaps not the best choice. If one wants to collaborate and co-create with



digital technologies, such as the AR tool to speculate futures, onboarding to the technology as well as usability needs to be considered in designing this process.

### **Attending to temporality in hybrid and digital co-creation**

Besides a deliberate selection of a tool in relation to the design cycle stage, another essential component to consider is the timespan of the collaborative activities. There is a huge contrast between activities scheduled in a workshop setting and pop-up activities such as in the BULL case. Workshops assume that participants reserve dedicated time, for example, two hours, to join in and engage in the collaborative activity. This provides room for onboarding, joint exploration of technologies, debugging and getting acquainted with digital tools or prototypes. A pop-up setting, such as the mobile teahouse in the BULL case, leaves less time for that because participants will serendipitously join the activity and often engage for only a few minutes. Similarly, the “postcards from the future” employed in Salzburg enabled participants to engage in a pop-up setup with highly complex topics such as novel interactive materials in built environments. Introducing prototypes in this setting does not work well because participants are not prepared for it and are not willing to take the time to be onboarded to the prototype. Often, these pop-up activities are set up in public and transitional spaces, where participants can engage “on the way” and are only available for a limited amount of time.

The component of time is related to the previous discussion on the quality of the materials in urban co-creation. Developing high quality materials requires a lot of time, but users can then apply the tool quickly without intensive training or onboarding. Developing analogue tools with the same kind of usability is less time-consuming and, therefore, seems to remain the preferred option, especially in pop-up and short urban co-creation activities. This component of time is a rather prominent differentiator between digital and analogue tools and is currently not explicitly outlined in the Co-Design Framework, while it has been marked as an important requirement for co-creation by others (Evans & Terrey, 2016).

These reflections support drawing up the following propositions on the role of digital technology in urban co-creation:

- Trust building and stakeholder familiarisation processes in the first stages of urban co-creation are best supported by analogue co-creation tools and activities.
- Using digital tools in urban co-creation runs the risk of participants getting distracted by technology flaws and bugs, hindering the co-creation process.
- Collaboration and co-creation with digital technologies are possible and engaging but require proper onboarding of participants and high usability standards.
- The temporality of the urban co-creation activities is a prominent factor in selecting digital or analogue tools; digital tools should only be used in pop-up or short activities when no onboarding is required.

### **Reflection on using the Co-Design Framework**

In the context of this paper, the five case studies discussed were mapped to the Co-Design Framework that combines the collaborative levels of the citizen participation ladder of Arnstein (1969) and the design cycle (Roozenburg & Eekels, 1995). In principle, the

framework was helpful in mapping the urban co-creation activities of all the five case studies. Notwithstanding, some adjustments were made to the framework for a clear demonstration of the individual activities their temporal components and for untangling the level of digitalisation of the mapped activities. The colour-coded dots in our graphics illustrate, for example, the characterisation as an analogue tool (blue dots) or digital tool (red dots) or as both (blue dots with red circles). In addition, the size of the dots and circles differs depending on the proportion of digital and analogue parts of an activity. Finally, assigning numbers to the activities that refer to the respective design cycles allowed us to track how activities were digitalised or became analogue throughout multiple iterations.

In general, the framework can support but not replace a qualitative description of the approach: for example, it is necessary to understand to what extent socio-cultural factors like the COVID-19 pandemic influenced the progress, as well as the availability of funding and personnel resources. In our case descriptions, which were reviewed by all authors, we also took into account other socio-cultural and climate factors which influenced the projects in general. We find that these also need to be described. Together with a qualitative description, the framework may visually point out certain tendencies of the process described and how the interconnection of analogue and digital tools may support the various levels of collaboration.

## CONCLUSIONS

Cities and local governments are increasingly involving residents and other urban stakeholders in the design of the city. This so-called participatory turn in urban planning has recently been further strengthened by the use of digital technologies, to open up co-creation practices to a wider variety of participants as well as to enable exploring potential futures together and creating a common understanding. In this paper, five cases of urban co-creation were mapped on the Co-Design Framework (Gaete Cruz et al., 2023), to untangle how this collaboration was shaped and which role digital technology took in it. This analysis served two purposes: first, to generate insights into how and when digitalisation supports urban co-creation, and at which stages of the design cycle analogue methods are to be preferred. Second, to explore whether this framework is useful to compare and contrast cases that vary from each other in terms of utilised tools, spatial scale, and timespan.

For the first purpose, our findings illustrate that in the initial stages of the collaboration, digital tools may be too distracting and not supporting to build rapport, trust, and common goals. Digital tools that are in a prototype stage, which often is the case in research projects, can be more difficult to use in a meaningful way because they are buggy and participants are not used to working with prototypes. Therefore, our suggestion is to consider usability needs as well as onboarding to the technology as essential elements when introducing digital tools in urban co-creation.

For the second purpose, our conclusion is that the framework is general and specific enough to map all of the selected cases and to compare them to each other. However, not all the terms of the design cycle (research, analysis, projection, selection) were considered to grasp the meaning of the activities; thus, one case adjusted two of the terms to better fit the case. Furthermore, the same case also added a level of collaboration that was deliberately left out by the authors of the Co-Design Framework, yet was needed to fully grasp the “Co-

Creation of a Residential Street Culture” case. Finally, the component of time is currently not visible within the framework, while in all five cases, this was an essential component to compare when certain activities happened, how they informed the next ones, and how both knowledge and the design were built through time. Our suggestion is to include the component of time, for example, using numbers to differentiate iterations as we did in the case descriptions.

This paper was strongly informed by discussions held during the workshop “Co-creation practices and technologies for open urban planning”, which took place at the 11<sup>th</sup> Communities and Technologies Conference in Lahti, Finland, in 2023 (Tellioglu et al., 2023). Therefore, the research and analysis have been shaped by the cases that were brought to the workshops and the workshop participants. However, since the cases differ from each other on various characteristics as discussed before, we consider this analysis still meaningful to explore the Co-Design Framework and the usage of digital tools in urban co-creation. The analysis presented in this paper, as well as the insights on digitalisation in urban co-creation can be picked up by others to 1) inform the design of future digital tools that are to be used in participatory urban planning, and 2) analyse their own cases using the Co-Design Framework to build the body of work on how collaboration works in urban planning and what is the role of digital technologies in urban design practices.

## **IMPLICATIONS FOR RESEARCH**

We are increasingly living in a hybrid world where participation occurs in both physical and digital spaces. Digital tools for co-creation offer new opportunities for involving various stakeholders in city-making, but there are no one-size-fits-all solutions. In line with our findings in this paper, we suggest future research should investigate how hybrid tools and practices may be further employed in urban co-creation processes, enabling citizens to participate both remotely and on-site in the early and late stages of design. How can novel technologies like AR support analogue tools and be embedded into long-term community-building and empowering processes? This question is also addressed in an ongoing international EU project “StreetForum”, in which several of the authors are involved: Digital and analogue tools are being further developed to promote sustainable consensus-building processes in the context of street transformation. The transferability of selected tools will be tested in Brussels, Istanbul, Stockholm and Vienna until 2025.

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### Authors' Note

The analysis and production of the journal article were supported in part by the following organisations:

FFG. [www.ffg.at](http://www.ffg.at),

Cultural Department of the City of Vienna (MA 7, Department of Science and Research Promotion),

Land Salzburg (WISS 2025) as a part of the project 5G Exploration Space Salzburg

Swiss National Science Foundation

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*Human Technology*  
ISSN 1795-6889  
<https://ht.csr-pub.eu>