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Collaborative Sensemaking of Design-Enabled Urban Innovations: The MappingDESIGNSCAPES Case

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Abstract. Wicked societal problems, such as environmental issues and climate change, are complex, networked problems involving numerous intertwined issues, no optimal solutions, and a wide range of stakeholders. Cities are problem owners and living labs for finding solutions through design-enabled innovation initiatives. However, to reach collective impact, it is paramount that these initiatives can learn from one another and align efforts through collaborative sensemaking. In the MappingDESIGNSCAPES project, we piloted a participatory collaboration mapping approach for cross-case sensemaking across design-enabled urban innovation initiatives. We used the CommunitySensor methodology for participatory community network mapping together with the Kumu online network visualization tool to help representatives of three urban prototype cases share and collectively make sense of their design lessons learnt. In this second of two papers, we build on the participatory mapping foundation introduced in [1]. We describe the collaborative sensemaking approach used, then present the core collaboration patterns and common perspectives that form the sensemaking scaffolding. We show how we collaboratively made sense by first taking individual perspectives, then making common sense together. An extended discussion puts our findings in a larger context of how an approach like MappingDESIGNSCAPES can be used to move from collaborative sensemaking to collective impact in design-driven urban innovation.

Keywords: Design-enabled urban innovation · Participatory mapping · Collaborative sensemaking · Collective impact

1 Introduction

In [1], we discussed how cities are instrumental in addressing wicked societal problems, such as climate change, environmental issues, and social exclusion. Besides being the locations where these problems manifest themselves, cities can also act as living labs to develop working solutions. We introduced the EU DESIGNSCAPES¹ program which aims to foster the building of capacity for design-enabled innovation in urban environments. We introduced the MappingDESIGNSCAPES project, in which we used the CommunitySensor methodology for participatory community network mapping [2], together with the Kumu online network visualization tool², to help representatives of selected DESIGNSCAPES urban prototypes share and collectively make sense of their urban design innovation lessons learnt.

In the previous paper we described how we developed two key knowledge resources – a conceptual framework and a visual knowledge base. Together, they form the participatory mapping knowledge foundation of the collaborative sensemaking process for design-enabled urban innovation that we piloted in MappingDESIGNSCAPES. We outline the collaborative sensemaking approach used in Sect. 2. In Sect. 3, we introduce the knowledge layer that forms the sensemaking scaffolding: a set of core collaboration patterns and common perspectives. In Sect. 4, we show how we used these perspectives to collaboratively make sense by first taking individual perspectives, then making common sense together. An extended discussion in Sect. 5 puts our findings in a larger context of how an approach like MappingDESIGNSCAPES can be used to move from collaborative sensemaking to collective impact in design-driven urban innovation settings. Discussion topics include participation as a multi-faceted process; how collaborative sensemaking can help diverse stakeholders see the bigger picture together; how using the right tools can amplify our collaborative mapping and sensemaking capabilities; and finally, how these capabilities can empower design-enabled urban innovation processes and help them accomplish more collective impact. We end the paper with conclusions.

2 Collaborative Sensemaking of Design Enabled Urban Innovations

Collaborative sensemaking is the goal of participatory collaboration mapping. Maps can quickly become overly complex to interpret in rich domains like urban innovation. In this section, we share how we operationalized the participatory mapping-driven process to collaboratively make sense of design-enabled urban innovations. We begin with some conceptual starting points, then outline the sensemaking approach we adopted in MappingDESIGNSCAPES.

2.1 Collaborative Sensemaking: Conceptual Starting Points

Sensemaking is commonly understood as the processes through which people interpret and give meaning to their experiences. However, these interpretive processes have taken

¹ <https://designscapes.eu/>.

² <http://kumu.io>.

on many different meanings, depending on by which academic discipline the term is being used [3].

In our own take, we base ourselves on the interpretation by Weick, who introduced sensemaking in the context of organizations [4]. One quote in particular sums up the essence for us: “To focus on sensemaking is to portray organizing as the experience of being thrown into an ongoing, unknowable, unpredictable streaming of experience in search of answers to the question, ‘what’s the story?’” [5]. This question, however, begs another question: *whose* story? Each stakeholder looks at the same complex collaboration reality from a different perspective and may have a very different story to tell about what, at first sight, is the same phenomenon. The parable of the “Blind Men and the Elephant” comes to mind: six blind men feel different parts of the same elephant. Each person, however, thinks it to be something very different, depending on whether they touch its trunk, leg, or tail. How now to make them see the whole, starting from their limited individual perspectives? [6].

In cross-boundary knowledge sharing, the interplay between brokers and boundary objects is of the essence [7]. Stories are an important tool in making sense within and across communities. In [8], we showed how an ongoing process of storytelling can help make sense across the boundaries of social innovation cases. Along similar lines, in MappingDESIGNSCAPES, stories and storytellers were to make sense together across their design innovation cases.

Very elaborate stories can often be told about just a few elements and connections. As these stories get told, deeper meanings of the connections between the elements are being teased out: what could be the implications of particular connections, or the lack of them? Additional stories can be told to explore further, triggered by participants noticing related elements and connections of particular interest to them. In short, participatory maps are not objective representations of the world. Instead, to community members their maps can be focal points and triggers for the sharing of rich, situated knowledge through sometimes very personal stories.

By having design innovators represent *their* elements, *their* connections, and *their* stories, they become owners and ambassadors of their case. Case elements can be connected via intermediate, boundary spanning concepts like the *DESIGNSCAPES Problems*, *Fields of Action*, and *Design Activities*. Through these boundary-spanning elements, stories across different cases can be connected and jointly made sense of. Through better joint understanding of commonalities and differences, new designs, collaborations, and ultimately increasingly collective impacts could be catalyzed.

To illustrate how this might be done in practice, we now outline our own participatory mapping-driven collaborative sensemaking process, as it grew out of our iterative efforts.

2.2 Collaborative Sensemaking: The MappingDESIGNSCAPES Approach

Collaborative sensemaking took place in several individual and cross-case online sessions. The emerging maps offered focal points for reflection and discussion. At the same time, the sessions helped in further bootstrapping the conceptual framework underlying the mapping and sensemaking.

In six joint online plenary sensemaking sessions we discussed the individual and cross-case maps. Using a set of initial, tentative perspectives, grounded in previous

related cases like BoostINNO, we started to get a sense of the “collaborative lay of the land”. Rather than working on increasing the level of detail of the case maps themselves, we focused our attention on further developing the structure and role of map *perspectives* in triggering, informing, and catalyzing the sensemaking process. In summary:

- On top of the conceptual framework, we defined a set of *core collaboration patterns*:
 - meaningful combinations of element and connection types acting as sensemaking contours.
- These collaboration patterns formed a conceptual foundation for subsequently defining a set of *common perspectives*. These are selections and visual renderings of elements and connections of a map that help stakeholders to jointly look in the same relevant but general direction when making sense across cases.
- Next, case representatives defined *individual perspectives* within those common perspectives. To do so, they further selected elements and connections from these common perspectives that were meaningful to them personally in characterizing a design situation about which they could tell a local *sensemaking story*.
- Finally, in a *joint sensemaking session*, case representatives presented and discussed each other’s sensemaking stories, enriching and connecting them and in this way arriving at new, collective lessons learnt.

3 Sensemaking Patterns and Perspectives

3.1 Core Collaboration Patterns

As we found out in our initial cross-case sensemaking efforts, it does not suffice to “unleash” the full complexity of the collaboration ecosystem upon the participants, for them to then somehow make sense productively. Sensemakers digesting the potential meaning of all present and possible concepts and connections at once does not work. Instead, participants need to be guided in their sensemaking conversations. What to focus on, though?

The first step toward finding a productive focus was provided by our conceptual framework’s core dimensions and concepts: the *Problem Domain*, *Project Scope*, and *Design* dimensions. However, how to proceed from there? We did not know of a theoretical, pre-defined starting point for collaborative sensemaking that would work in (our) practice.

As an intermediate conceptual scaffolding, we defined a number of *core collaboration patterns*. Collaboration patterns are conceptual structures that model the essence of the socio-technical systems of collaborative communities and can be used to capture collaborative lessons learned in, for instance, social innovation cases [9]. In the MappingDESIGNSCAPES case, starting points for defining its collaboration patterns were the individual and cross-case problem domain, project scope, and design maps that had already been validated when discussing them through their initial, still quite generic perspectives.

An example of a collaboration pattern that we kept revisiting and which helped generate many insights about the various maps was the *Problem Domains*-collaboration pattern (Fig. 1). This collaboration pattern focuses on the relationships between the

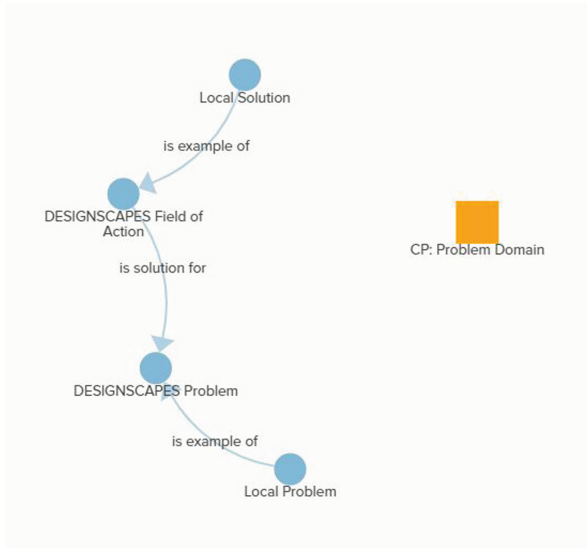


Fig. 1. The Problem *Domains* collaboration pattern

problems and solutions within and across cases. The *DESIGNSCAPES Problems* and *Fields of Action* provide the conceptual common ground, with the *Local Problems* and *Local Solutions* case examples of those concepts. This collaboration pattern is an excellent example of identifying minimal conceptual common ground between the cases. Individual cases may also have additional conceptualizations not part of the cross-case common ground. For example, some local problems and solutions were further classified by locally-defined knowledge categories, such as the design proposal categories identified in The Landmarks Net [1].

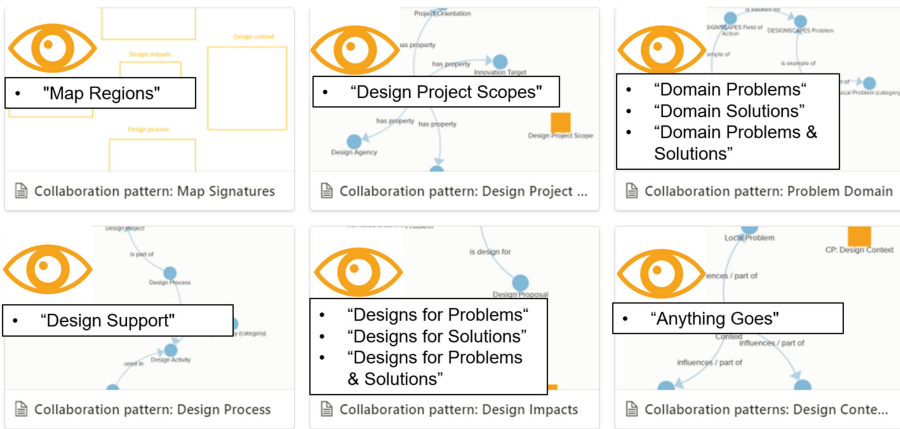
After our iterations, we identified six core collaboration patterns: *Map Signatures*, *Problem Domains*, *Design Project Scopes*, *Design Processes*, *Design Contexts*, and *Design Impacts*. Each pattern captures meaningful combinations of element types and connection types that form a relevant starting point for productive sensemaking conversations about design-enabled innovations. They were elicited in practice and are not meant to be seen as *the* patterns for all design-enabled urban innovation projects everywhere. The criterion for a collaboration pattern to be included in the set was pragmatic: it turned out to have been a focal point for productive conversations, as surfaced in our open-ended individual and joint sensemaking sessions. Still, as they turned out to help make sense across cases as diverse as in our project, we think they are interesting starting points for future conceptual framework development and case analysis.

The collaboration patterns were still only conceptual constructs. To make them work in practice, we further refined and visualized them by applying specific filters and layouts in *common perspectives*.

3.2 Common Perspectives

A perspective is a particular way of considering something. We define a map perspective as a selection of elements, connections, and layout that helps viewers focus on a part of a map in a way that is most relevant for a particular purpose of reflection. Even though there is only a finite set of elements and connections in a visual knowledge base, the number of perspectives through which to look at them is infinite. For example, a comprehensive bird’s eye perspective on each collaboration pattern helps to see the big picture of where the action is – or is not. However, there are many ways to zoom in further and visualize those selections.

To guide participants in making sense across their cases with greater efficacy, we defined – for each collaboration pattern – one or more common perspectives. A common perspective is a perspective that uses a particular layout to show a meaningful selection of elements and connections circumscribed by a collaboration pattern. Common perspectives help participants make sense within and across cases more effectively and efficiently. Our common perspectives were empirically defined. We created them by informally analyzing in retrospect what our initial, cross-case sensemaking conversations tended to drift towards. In doing so, we noticed which of the selections of elements and connections, shown in what particular visualizations, triggered the most focused, rich, and energetic conversations.



“The **common perspectives** help us to all look in the same direction, the **individual perspectives** are what each of us sees then.”

Fig. 2. Common perspectives (organized by collaboration pattern)

We defined ten common perspectives on our six collaboration patterns (Fig. 2).

To show how they may be applied, we give examples of how we used the common perspectives in our case. Each perspective is applied to either an individual case seed map or a cross-case map, as a perspective is meaningless without an underlying map.

Common Perspective: Map Regions

In the previous paper, we explained how we developed the idea of map regions to provide topological cues for making sense of design-enabled innovations: at the top of each map, we positioned the *Problem Domain*, on the left-hand side the *Project Scope*, the *Design Processes* at the bottom, the *Design Outputs* in the middle, and the *Design Contexts* on the right-hand side.

This perspective helps to quickly get a broad sense of where the design focus of a particular case is. In this perspective applied to The Landmarks Net map, for instance, immediately the large number of design proposals stood out, as we saw in ([1], Fig. 7). However, we can also compare the different case maps by positioning them next to one another and comparing their topologies (Fig. 3).

This cross-case comparison confirms that *The Landmarks Net* has many more proposals than the other two cases. Similarly, *CityBarge* has a significant problem domain compared to the others, particularly *SciberCity*. Both observations indeed led to engaging discussions.



Fig. 3. Common perspective *Map Regions* applied to cross-case map

Common Perspective: Design Project Scopes

Initially, in the *Design Project Scopes*-collaboration pattern, we had just defined the overall perspective on the map showing all elements and connections related to the design project scope. In the next iteration of this perspective, we refined several things. We greyed out those elements that had only one connection. This means that one can immediately focus on those elements with two or more connections, which means that at least two cases have that element in common. We also increased the relative size of the elements depending on the number of connections that comes in (Fig. 4).

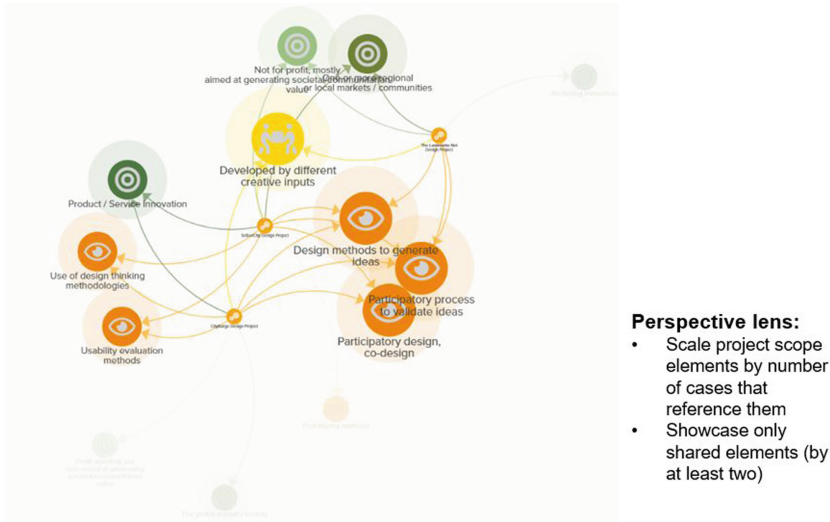


Fig. 4. Common perspective *Design Project Scopes* applied to cross-case map

This is an example of the evolution of a common perspective, consisting of changing element and connection selections and applying layout refinements that help participants focus better on what matters from their common ground-point of view.

Common Perspective: Domain Problems

The previous example applied the *Design Project Scopes*-perspective to the cross-case map. A common perspective can also be applied to individual case maps to see how they relate to the conceptual common ground. In the following example, we applied the *Domain Problems*-common perspective – comparing local problems to the DESIGNSCAPES problems – to the CityBarge seed map (Fig. 5).

We see that the problem focuses of CityBarge included not only *Crisis of Values* but also, for instance, *Economic Crisis*, giving an additional starting point for an exploratory discussion. In this perspective, the (common) DESIGNSCAPES Problems are scaled by the number of incoming connections. Although the perspective was applied to the CityBarge local map, we did not size the DESIGNSCAPES problems depending on how often CityBarge local problems link to them. Instead, those elements were sized by the incoming connections *for all maps*, as calculated in the *Problem Domains cross-case map*. This means that the size of those common DESIGNSCAPES Problem-elements is a rough visual indicator for how important *all the cases together* find this concept to be. One could say that this common perspective applied to the CityBarge map shows how much this project might contribute to what “Europe as a whole” thinks to be societally important.

Although a common perspective applied to an individual case in first instance benefits representatives of that case, its usefulness may go beyond them. In this example,

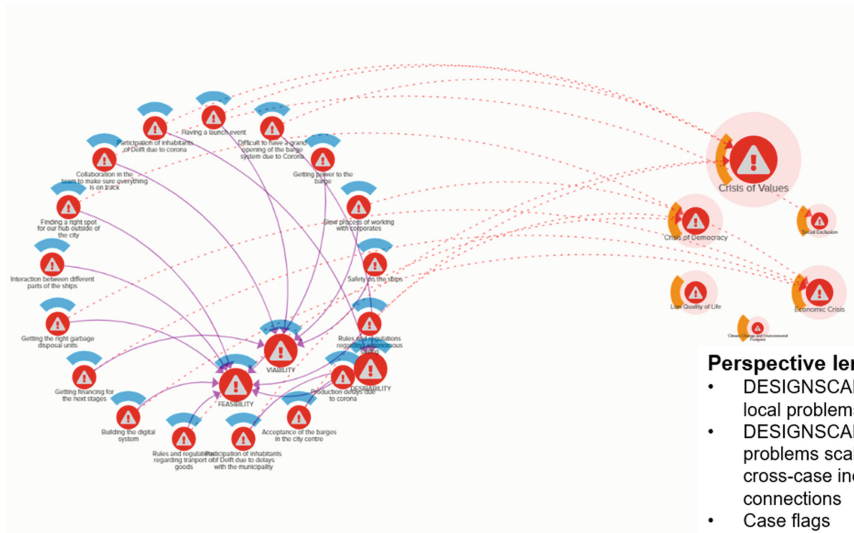


Fig. 5. Common perspective *Domain Problems* applied to CityBarge map

CityBarge representatives initially could have a story to tell around their local problem-category *Viability*. SciberCity looking at the CityBarge map from this common perspective, however, could say that they also recognize the local CityBarge problem of the *Slow process of working with corporates*, as they had to deal with that problem in their Finnish context.

Common Perspective: Design Support

In this perspective, we mainly look at the design activities and tools making up the design process. It only shows the tools that support at least one activity. Colored “flags” indicate the colors of the case, with brown flags indicating common concepts, such as design activities. In Fig. 6, we applied this perspective to the SciberCity case map:

One observation immediately standing out is the size (and thus of the number of incoming connections representing uses) of the *Co-Creation Workshop* tool (on the left), which is linked to many different design activities. We also see that it is connected by many *thin* brown lines, indicating that this tool was *planned* to be used but not used in reality in the design processes of the various cases. This, as discussed before, was a direct effect of the COVID crisis. It is an extreme case of what often happens in design trajectories: the discrepancy between design plans and realizations, which is a fruitful starting point for sensemaking stories and discussions.

Common Perspective: Designs for Solutions

Designs for Solutions is a common perspective that is grounded in the *Design Impacts-collaboration* pattern, which is about what these designs (may) contribute to in the real world (Fig. 7). The yellow flags stand for The Landmarks Net, which offers numerous local solution proposals, grouped into three categories. In particular, their *History and identity connection* is linked to many *DESIGNSCAPES Fields of Action*, such as *Urban*

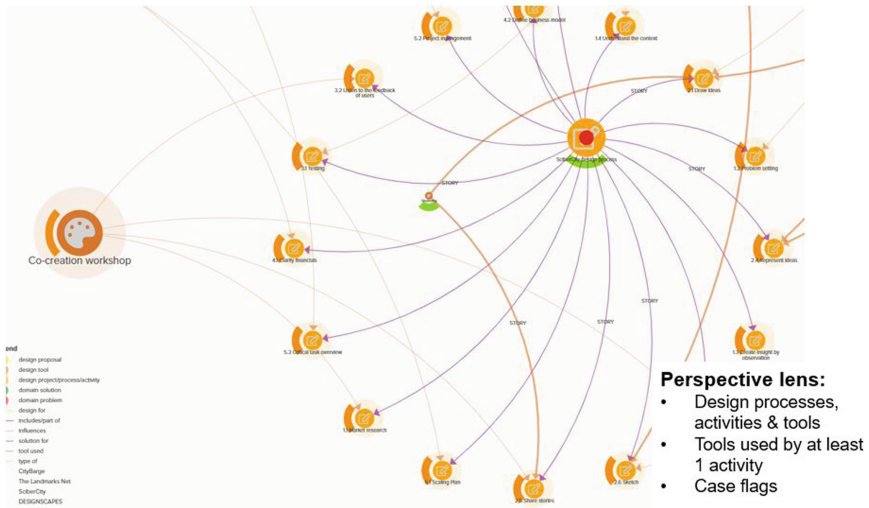


Fig. 6. Common perspective *Design Support* applied to the SciberCity map.

Space Quality, Intergenerational Dialogue, and People’s Participation. So, in terms of design priority and focus, design proposals contributing to this local solution category may be important ones to consider, at least in the Landmarks Net case. Beyond that, the Landmarks Net case may provide other cases about greening their cities with many concrete and inspiring ideas on addressing the linked common fields of action in their cases.

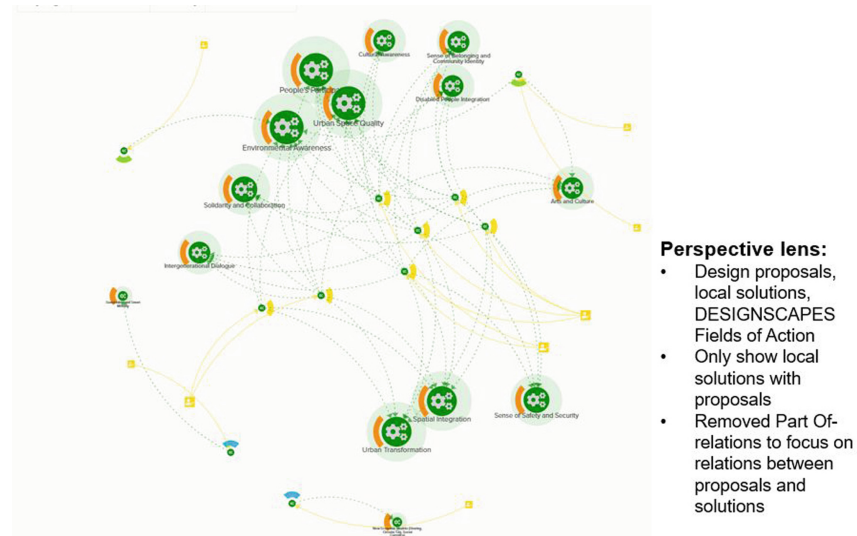


Fig. 7. The *Design for Solutions* common perspective applied to the cross-case map

4.2 Making Common Sense

Participants representing different cases compared and contrasted their individual perspectives in a final joint sensemaking activity. They interpreted commonalities and differences by “looking through each other’s eyes.” This entailed reading and discussing the individual sensemaking stories they had each contributed. In their collective discussion, they added another layer of interpretation of what the perspectives and stories may mean and imply regarding issues, priorities, and subsequent actions.

To illustrate this final common sensemaking step: another sensemaking story was told by The Landmarks Net, who applied to their case the *Designs for Problems*-common perspective of the same collaboration pattern SciberCity picked: *Design Impacts* (Fig. 9). In essence, their story “*Democratic use of space*” was that communal green spaces in the city are not just about feeling good and healthy as individual citizens, but also that they have a political dimension, including economic, environmental, and democratic empowerment aspects. Their individual perspective showed that their proposal categories of *Historical identity*, *Sentimental interaction*, and *Connecting with nature* (which had come out of their first round of internal sensemaking discussions) provided concrete ways to go about many of their local problems, like *Not enough green mass*, *No spatial identity*, etc. From their perspective, these local problems were clear examples of the *Crisis of Democracy-DESIGNSCAPES* (common ground) problem. In our final joint sensemaking session,

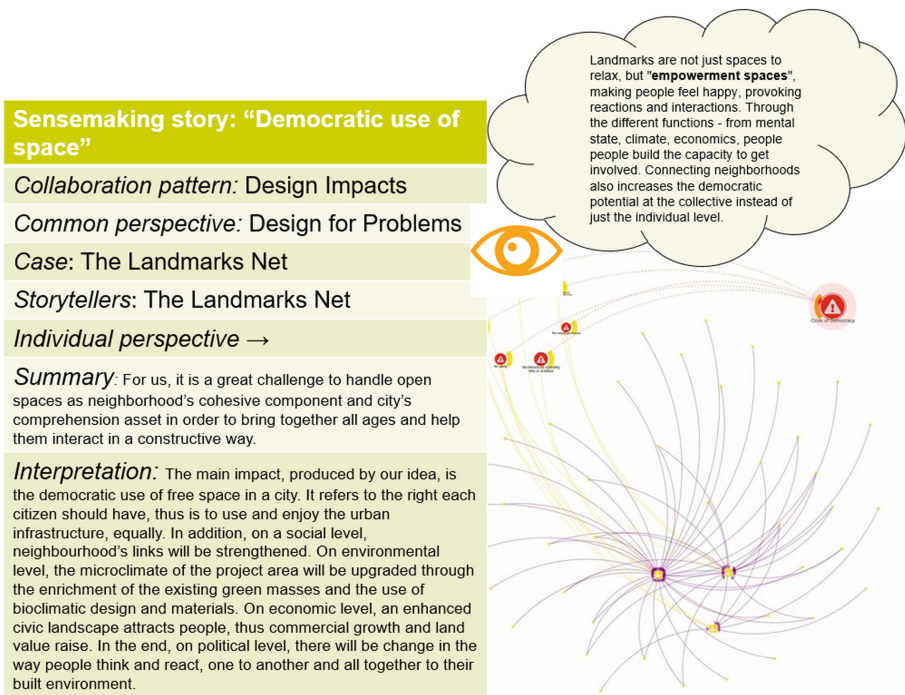


Fig. 9. Making common sense: co-imagining “empowerment spaces”

we discussed this particular sensemaking story, ultimately together coming up with the idea of “empowerment spaces.”

5 From Collaborative Sensemaking to Collective Impact

In this paper, we described how we made collaborative sense across local design-enabled urban innovations using a visual knowledge base created in the process of participatory collaboration mapping, as we described in [1]. The goal of the MappingDESIGNSCAPES “urban prototype” project was to provide a practical proof of concept of how to go about such a mapping-driven cross-case sensemaking process.

In this section, we reflect on our lessons learned and point at future research and development directions on participatory mapping-driven collaborative sensemaking in an urban design innovation context. We do this at length since our proof of concept should be firmly embedded in different strands of thinking and practice to take root and further prove its potential. We start by examining what we mean by “participation” in participatory collaboration mapping and the collaborative sensemaking guided by the maps created. We then move from conceptual foundation via sensemaking practice to – hopefully – societal impact. We do so by examining participation as a multi-faceted process, then finding out how sensemaking depends on seeing the bigger picture together, exploring the tools supporting this process, and finally moving to reflect on how to embed such processes in larger urban contexts catalyzing societal transformations.

5.1 Participation: A Multi-faceted Process

Achieving measurable outputs and outcomes of the prototyping cases is not the immediate goal of using MappingDESIGNSCAPES. The direct benefits for the participants are that they get deeper insights into their project scopes, meanings, and (potential) impacts through the cross-case, participatory mapping-based collaborative sensemaking process. This provides ideas directly usable in their own design trajectories (e.g., the citizen project proposal categories identified in the Landmark Nets case) and helps case representatives document and present their project results once their project has finished.

A general precondition for pilot/prototype participants to engage in a collaborative sensemaking process like MappingDESIGNSCAPES is that they are willing to reflect, learn, and collaborate. Such an involved process is particularly suited for collaboration ecosystems addressing wicked problems, with the problem and solution spaces and stakeholder networks being fuzzy and requiring multiple perspectives to make actionable sense of. The overall DESIGNSCAPES program had already preselected cases that met these conditions. Within that range, for MappingDESIGNSCAPES, we further selected cases on the criteria of motivation, regional EU distribution, and variety in design challenges. This helped create an interesting mix of highly motivated case representatives with enough in common yet also experiencing enriching differences to make for engaging and ongoing conversation and collaboration.

Our methodology of using participatory collaboration mapping to make sense within and across urban design innovation cases is within the tradition of participatory design

between the public sector and local communities. In such design collaborations, participation is multi-faceted and far from trivial, requiring answers to thorny issues like whether to empower citizens or municipal workers; to promote participation for now or for long-term future ideas; and whether to effectively involve just the vanguards or everybody [10]. Other bottlenecks, specifically in participatory mapping processes, include participatory options not being actively propagated by the responsible authorities, there not being a specific enough interest for the public, and, especially in the early stages, there not being a legally binding obligation to include the voices of the public [11].

We far from addressed all these participation issues, but at least explicitly surfaced many in our discussions and dealt with some of them in our projects:

- The level and type of participation in the design processes differed widely in each case. For example, CityBarge and SciberCity worked with dedicated, small, semi-professional design teams involved in the full process, from ideation to prototype definition. In The Landmarks Net case, however, many citizens submitted rudimentary design visions, which were then processed by a small team of urban design professionals.
- The Landmarks Net created a role for local institutional stakeholders to *catalyze* participation of other stakeholders in the design: city hall and local newspapers were instrumental in promoting the design project, which led to a high number of green space proposals from citizens.
- As we have argued, participation is not just necessary in the design process itself but also in the reflective sensemaking *about* the design processes, in both of which processes participatory collaboration mapping can be helpful. In our case, participation of local stakeholders in design sensemaking was only partial; however, case *representatives* created and made sense across their maps *on behalf of* their stakeholders, constrained as they were by the COVID pandemic in organizing local activities. In contrast: in a case on strengthening agricultural collaborations in Malawi, we involved villagers directly in physical collaborative sensemaking by having them first map their local collaboration ecosystems, with mapping professionals only present as facilitators. They then jointly discussed the connections they observed between their different (cross-case) maps [12]. One intriguing exception to the lack of direct stakeholder collaborative sensemaking participation in our project happened in The Landmarks Net case. An online portal was used to display citizen design proposals alongside another as they were being submitted, triggering other citizens also to submit a proposal of their own. Finding effective co-design combinations of shared (material/digital) objects and processes can empower citizens and local communities [13]. In future (post-COVID) work, we would like to develop such hybrid combinations further.
- Note that creating a shared vision, brainstorming, exchanging creative ideas, and evaluating them in diverse multi-stakeholder partnerships presupposes first devising a shared language to reach a common understanding [14]. One fundamental process of participation – often forgotten in co-design- was having case representatives co-define the visual *language* they used to construct their maps and make sense of them. This is what we explored in the previous paper [1]. However, to further scale reflection within the collaboration ecosystem, co-definition of meanings through collaborative sensemaking is key to connecting the variety of collaborators in the ecosystem and

ensuring ownership not only of the visual language but also of the respective outcomes in order to scale the reflective practices with efficacy.

5.2 Collaborative Sensemaking: Seeing the Bigger Picture Together

How now to use these maps created in a participatory way? Collaborative sensemaking involves new understandings, processes, and tools in which stakeholders across the board collaborate in complex thinking and decision-making processes [15]. Selvin and Shum make a case for knowledge cartography. This is about improving our capacity to create and use human-interpreted higher-level visualizations, complementing low-level, machine-driven pattern-mining approaches like big data and simulation. Through knowledge cartography, we can “grow our collective capacity for sensemaking: to make sense of overwhelming amounts of data; to assess conflicting judgments about its trustworthiness; to resolve polarized interpretations about the implications, and to negotiate effective courses of action that all parties can commit to” [16].

Sensemaking departs from the premise that humans live in a world of gaps, which participatory mapping approaches can help span [17]. Bridging these gaps between conceptual knowledge and the lived stories within and between the cases in which these concepts are applied – is at the core of MappingDESIGNSCAPES. Such conceptual bridge-building takes place at many levels. Participants first used the various maps to make sense of their local urban design innovation cases, showing considerable socio-technical complexity. By mapping their local terminologies (e.g., their *Local Problems/Solutions*) to more generic (DESIGNSCAPES) categories, they were inspired to think more deeply about the meaning of their cases. For example, in The Landmarks Net, our collaborative sensemaking helped them to distinguish knowledge categories to classify their numerous citizen design proposals. This added a whole new layer of meaning to their project and helped them make better sense of the thrust of it. COVID prevented physical local design workshops, but in future work, the maps and sensemaking stories collected could also be inputs for follow-up local, reflective, and action-generating efforts. Second, the methodology helped make sense across the cases, identifying the deeper meanings connecting them. For example, we discussed urban design innovations’ values and emancipatory potentials during our joint sensemaking sessions. This could be called a process of triple-loop social learning. Whereas second-loop learning is about exploring the context of new situations that do not fit existing patterns and schemes, third-loop learning also explores the deeper guiding norms, values, and paradigms underlying the cases [18].

Collaboration patterns and common perspectives played a fundamental role in our sensemaking approach. These intermediate conceptual structures helped to catalyze and focus the collaborative sensemaking process and to tease out the higher-order learnings from the maps. We created these patterns and perspectives inductively, co-evolving them through our initial conceptual framework, the case seed maps, the cross-case maps, the stories, and all the conversations that emerged around them. As we explored the maps and tinkered with the perspectives, we found out what concepts and connections the participants deemed essential and how to make sense of them in practice.

In other urban design-enabled innovation contexts, civic hackathons prototypes have been used as boundary objects to consolidate ideas and communicate/reflect on them [19]. It would be interesting to see how hacking prototypes and collaboration ecosystem

maps agree and differ in their boundary-spanning roles for looking back versus forward in collaborative sensemaking (cf the retrospective and forward-looking action-orientated aspects of organizational sensemaking [5]). We hypothesize that hacking prototypes trigger design discussions of more immediate problem-solving concerns to stakeholders. Collaboration ecosystem maps are explicitly grounded in problem domains, thus making more significant societal concerns explicit (such as in the DESIGNSCAPES problems and fields of action). They may thus steer reflection in a longer-term, societal-orientated direction. Post-COVID, we would like to pursue experiments with hybrids of hackathon prototyping- and map-driven collaborative sensemaking activities. This could also include approaches to gamify mapping outcomes and use them to catalyze sensemapping efforts in stakeholder workshops [20].

To formalize our elaborate collaborative sensemaking process, we propose the notion of a “sensemaking ladder,” which stakeholders could climb, moving from understanding the core concepts in common to achieving scalable collective impact (Fig. 10). Many different kinds of ladders have been proposed in the field of information and knowledge systems. An example is the “semiotic ladder,” in which the lowest level refers to the material world of physical signs, and the highest level comprises the social world of shared understanding [21]. Another example is the “Reader-to-Leader Framework,” in which social media users move from mere readers of content to becoming engaged leaders in their community [22].



Fig. 10. The sensemaking ladder

Climbing the ladder, one starts on a solid shared meaning foundation of a *conceptual framework*. Stakeholders then use local and common concepts from the conceptual framework to represent meaningful (to them) parts of their cases in *individual case maps*. These (seed) maps are aggregated in *cross-case maps*. Collaboration patterns are distilled from a growing body of cases to make sense of the maps. Based on this collaboration pattern foundation, a set of *common perspectives* is defined that help stakeholders look in the same general direction around relevant topics of interest. Within these common perspectives, stakeholders then define their *individual perspectives*, which they interpret

by telling their own *sensemaking stories*. In joint discussions, *common interpretations* are co-created, enriching and interlinking the individual stories. We think this alternating between individual and collective meaning-making to be a fundamental contribution of our project. Not studied yet in this pilot, but part of future work will be to translate these insights into collective actions and impacts, in which common agenda setting plays a key role [23].

Some final words about the all-important role of storytelling in collaborative sensemaking. Storytelling has long been acknowledged as a crucial approach toward sensemaking in organizations and communities, increasingly also being supported by digital technologies [24, 25]. In MappingDESIGNSCAPES, individual and collective sensemaking stories were the main instrument for capturing and contrasting the meanings of the maps. Crucial, especially in societal application domains like social and urban innovation, is to ensure the quality of both the stories and the processes in which they are created, shared, and applied. In [8], we proposed a storytelling cycle of trust: a conceptual framework to help ensure the legitimacy and authenticity of the stories being told; the synergy in combining stories to represent multiple stakeholder perspectives; and the commons (such as online repositories) in which stories can be discovered and used to help span boundaries across cases and domains. With the expanded collaborative sensemaking framework presented in this paper, it would be of great interest to revisit that storytelling cycle.

5.3 Using the Right Tools: Amplifying Collaborative Mapping and Sensemaking

Creating and using relevant map representations was essential in participatory mapping and collaborative sensemaking. The right tools can make a difference in supporting these complex collaborative processes. A core tool for us was the online network visualization platform Kumu. This tool is particularly useful for our purposes because of its features to create elaborate and customized perspectives. The tool enables these to be automatically generated based on the types and properties of the elements and connections mapped. We already mentioned the overview effect. From what could be called a user interface point of view, one possible explanation for this effect is that Earth's holistic features against the blackness of space emphasize both the perceptual and conceptual themes and feelings of awe [26]. Discovering what perceptual and conceptual themes might strengthen overview effects in collaborative sensemaking in urban societal contexts might be a fruitful line of inquiry.

Despite its many capabilities, Kumu comes with its technical limitations. For example, if multiple participants add an element with the same type and label, the most recently added version overwrites the properties of those added earlier. Another limitation is that multiple connections of the same type between the same two elements are superimposed upon one another. This is problematic when engaging in collaborative mapping and sensemaking, as distinguishing between multiple stakeholder points of view is paramount.

Other tools might be useful as well. [27] give an overview of types of tools of particular relevance to design-enabled urban innovation, from “personas” and “Idea Evaluation Matrix” to “Value Proposition Canvas” and “design orienting scenarios”. The wise use of such tools could further enrich our mapping and sensemaking processes. However,

research on which (combinations of) design tools to use and how best to use them is still in its infancy, especially in complex societal design contexts. In reviewing the related class of creativity support tools, [28] conclude that it is hard to make an authoritative tool usefulness assessment. Instead, they propose to evaluate such tools on specific dimensions, like particular types of user groups, forms of interfaces, complexity, or phases of the creative process supported. Interestingly, they do not mention the social/societal context these tools might be classified on. Our societal context-orientated approach explicitly tackles this context. By making sense of the problem domain and the (potential) impact designs might have in addressing wicked urban problems, our approach helps fill this gap.

Finally, we looked at sensemaking stories as individual and collaborative interpretations of the societal context of design tools. We left the associated discussion processes themselves as black boxes. An interesting related field is contested collective intelligence. For example, the visual analytics of debates can bring more structure and sensemaking power to these discussion processes [29]. In future work, we hope to explore further how such “argumentation mapping” may augment the societal context domain mapping we have been exploring in MappingDESIGNSCAPES.

5.4 Design-Enabled Urban Innovation: Towards Collective Impact

Design-enabled urban innovation “[should] be more than the injection of design methods and tools into innovative activities. It has to be about creating a diffuse design attitude, including the capability of ‘listening to the context,’ the capacity to support participation, the ability to synthesize and visualize solutions, the skill to devise complex solution architectures, and the attitude to connect ‘micro’ initiatives with ‘macro’ infrastructural interventions [30, p. 8]”. Our approach helps build this capability to listen to the context and synthesize and visualize solutions bridging the gap between micro-initiatives and macro-context.

The MappingDESIGNSCAPES approach is in line with the overall ambition of the DESIGNSCAPES capacity-building program. It can be seen as a complementary tool to spur the reflective practice among urban initiatives and their ecosystems [31]. The DESIGNSCAPES program identified the roles and capabilities of various stakeholders in the awarded pilots. It developed a capacity-building program through a cross-project understanding of the tools, processes, instruments, and techniques in design-enabled innovation to stimulate the full potential of design to trigger a systemic change in tackling societal challenges. The program showed that financial support stimulated the use of design (methods) in developing solutions and broadening design capacity. Within this context, the premise is that strengthening the collaboration and exchange among different urban innovators could facilitate the scaling of their best practices and ultimately increase the impact of these urban initiatives. In other words, for enabling urban transformations that tackle complex issues, developing more systematically collaborative learning and co-creative partnerships is critical [32]. At the same time, to facilitate the adoption of such radical social innovation at an urban scale, urban innovation processes need to consider a broad range of stakeholders: a collaboration ecosystem. Our participatory and visual methodology helps scale the reflective practice and ensure ownership within the collaboration ecosystem. As said before, it is not straightforward whom to select to

ensure representative participation, as the methodology is quite time-consuming. In an ideal situation, all actors within the collaboration ecosystem are part of the collaboration mapping and sensemaking process, allowing the effective translation of interpretations into action directions. MappingDESIGNSCAPES at least has the potential to act as a bi-directional action repertoire. First, it facilitates the translation of the common interpretations into project-specific actions and helps stakeholders to transfer the lessons into their urban contexts. Second, it provides ideas for, for instance, program management for more impactful interventions at the meso (“regime”) and macro (“scape”) levels. More specifically, participatory mapping-driven collaborative sensemaking of experimentation within and across local pilots, through relevant perspectives and stories, could help better identify the roles and capacities of various stakeholders, including local government and EU policy-making processes.

The MappingDESIGNSCAPES methodology is in the spirit of approaches like exploratory data work, which mainly supports the problem-finding stage in the early stages of the design of urban innovations. In this process, framing what data to collect is crucial and non-trivial [33, 34]. However, instead of scraping and interpreting open data from social media, we co-defined and made sense – through storytelling and ongoing conversations – of meaningful *concepts* framing the connections between problems, solutions, and designs, guided by a solid underlying conceptual framework. It would be interesting to explore how these exploratory conceptual and data-driven approaches for urban innovation design might complement one another in future work.

A strength we observed in all the cases was the flexibility of their design processes, in quickly adapting to rapidly changing circumstances and formidable obstacles such as the COVID crisis. We think this flexibility and resilience might be a fundamental property that all design-enabled urban innovation cases (should) have. Although on the surface, the design proposals differ considerably from what was described in the original project proposals, the underlying fundamental design values and qualities are still very much present. As we demonstrated, participatory mapping and collaborative sensemaking – grounded in solid conceptual models of design-enabled innovation – could further increase the flexibility, resilience, interconnectivity, and collective impact of design projects and programs by reflecting on their “core values space.”

Collective impact implies the commitment of stakeholders from different sectors to a common agenda for solving specific social problems. Realizing this impact requires a systemic approach to social impact that focuses on the relationships between organizations and the progress towards shared objectives [35]. It also means that individual initiatives need to be aligned. Such alignment requires focusing on what outcomes to achieve and drawing a big picture to see how and why efforts need to be connected [36]. In MappingDESIGNSCAPES, we inductively developed an impact-orientated conceptual framework and validated it using it in individual and cross-case design sensemaking practice. A way to scale up the use of such cross-case participatory collaboration mapping approaches towards collective impact was pioneered in the related CIDES project. This project was about strengthening the role of Czech local public libraries in developing design-enabled social innovations. In that project, we applied CommunitySensor as part of a situated Research through Design-methodology. By integrating design thinking and participatory community network mapping, we helped catalyze and connect local

social innovation incubators across the Czech Republic [37]. In future work, we hope to integrate incubator-driven scaling-up processes with participatory mapping-driven collaborative sensemaking approaches, as presented in this paper. Combining the power of collaborative sensemaking with the ability to scale up and connect urban innovation initiatives should make the long and winding road towards collective impact somewhat easier to travel.

Socio-technical transitions take place in a complex, dynamic ecology of mainstream regimes, innovating niches, and a macro-level landscape context, requiring multi-level perspectives to make sense of them [38]. We have provided a conceptual lens for innovation niches to position themselves in the broader set of regimes and scapes, offering a more precise overview of and focus on relevant issues at stake. Zooming out, participatory collaboration mapping and collaborative sensemaking might also help to transform design project contexts themselves towards transition, at least at the regime level [39], but perhaps also towards design for scapes that “embraces a multi-level perspective and addresses shifts in dimension and scale and aims for an expanded long-lasting impact of the design action across wider contexts of application in response to global societal challenges” [40]. Different transition pathways have been identified to move between these levels [41], which our approach could help augment and catalyze. One example is our *Design Impacts* collaboration pattern. This pattern connects designs/proposals with the local problems and solutions, which in turn are examples of the larger societal (DESIGNSCAPES) problems and fields of action. This may support one of the main aims of urban living labs: facilitating urban transitions through an accumulation of experiments. Although they have proven successful at the meso (i.e., project) level, urban living labs still lack more formal value capture and retention processes at the macro (i.e., ecosystems and overarching organization) level [42]. Using our approach in the context of urban living labs, we can meaningfully connect many projects, making both conceptual and actionable sense across cases. Abstract capacity-building programs can thus become more alive and actionable by grounding them in relevant aspects of local cases while strengthening the participation, collaboration, and visibility of numerous local stakeholders. This combination may help locals become true co-designers: creating concrete, feasible ideas for tackling collective issues that reflect the knowledge and experience of those most impacted by the challenges at hand [43].

Finally, some thoughts on the possible contribution of our approach to research methodology. Design-enabled innovations take place in a unique context of niches, regimes, and scapes; have very flexible design trajectories; and are often complicated by unforeseen external pressures, like COVID and climate change. They are typically not replicable nor fit typical randomly controlled trial research. Our research methodology could be considered a type of mid-range theory formation. On the one hand, this acknowledges the importance of abstraction, representation, and refinement of general principles that apply across multiple situations. On the other hand, it recognizes the limitations of such abstractions in accurately representing emergent, contingent, and locally specific reality [44]. Our seed and cross-case maps help make sense by viewing them through various relevant perspectives and could be seen as collections of concrete design hypotheses and examples. For instance, they suggest what specific impacts particular (types of) design proposals may have on the types of wicked problems

and solutions addressed in the regimes and scapes that more theory-orientated design-enabled innovation research is working on. Connected to the visual knowledge base are also the sensemaking stories and linkages to representatives of the local communities that theory-building researchers could engage with in follow-up conversations. As such, they could be seen as a form of grounded theory-building research capacity. In such research, emerging theory helps explain, in conceptual terms, what is going on in the substantive field of research [45]. For example, the proposal categories developed in The Landmarks Net case could be considered hypotheses about green spaces' critical roles in urban innovation contexts. Through their conceptual connections, sensemaking stories across cases can be contrasted, creating a scalable knowledge base of cross-case qualitative data and interpretations. This, in turn, could inform theory construction and testing about the societal effects of design-enabled urban innovations.

6 Conclusion

Addressing wicked problems such as climate change requires societal transitions fast. Design-enabled urban innovations help blaze the trails we urgently need to address the immense challenges we face. However, to build collective impact at the scale needed, we must go beyond promoting individual innovation initiatives, often taking place in isolation. Crucial is that we can collaboratively make sense of the multitude of initiatives, projects, and programs and find conceptual and actionable common ground toward collective societal impact. It is necessary to catalyze the sharing of lessons learned, the discovery of new collaborative connections, and forging coalitions for impact at the local, regional, and international levels. However, how to collaboratively make societal sense with efficacy across design-enabled urban innovation cases is not trivial. Practical methodologies for scalable cross-case sensemaking and coalition building are needed, yet few and far between.

In this and the accompanying paper [1], we outlined one promising approach for participatory mapping-driven collaborative sensemaking across design-enabled urban innovations: the MappingDESIGNSCAPES methodology. At its core is a participatory collaboration mapping methodology grounded in two knowledge resources: a conceptual framework and a visual knowledge base of individual and cross-case maps, common and individual perspectives, and sensemaking stories. We presented a practical collaborative sensemaking process built on these knowledge resource foundations. We described at length our considerations – from initial conceptual grounding to impactful societal application. We do not claim to have found definitive answers to the collaborative sensemaking challenges we face, although we think we showed a sound proof of concept. By sharing the details of our still tentative tale, we hope we inspire others to build or adapt related approaches.

In dealing with global challenges through local innovation, “*the need to activate values and meanings that are crucial for the transformation process* is unquestionable [46, p. 6, our emphasis]”. Through MappingDESIGNSCAPES, we hope to have contributed to unlocking such values and meanings in design-enabled urban innovation in Europe and beyond.

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