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# Revealing the role of values in developing a garden data ecosystem through a reflective participatory design approach

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## ABSTRACT

Data-driven domains such as public administration, health or mobility have adopted a so-called ‘data ecosystem’ perspective to unify the socio-technical aspects fostering data-driven collaboration. While a data ecosystem is technically able to collect and merge their different datasets, it is yet relatively unable to facilitate meaningful forms of collaboration between actors. Based on previous research on value creation in data ecosystems, we hypothesize that this inability is mainly due to ecosystems not reflecting actor values, i.e. aspects which are important and imply a desirable behavior, often related to goals, objectives, motivations and decision making. This paper therefore proposes a reflective approach to reveal the values in data-driven collaboration by answering the following research questions: What role do values play in the process of developing a data ecosystem? And how can value-led participatory design support data-driven collaboration? We attempt to answer these questions through an exploratory study based on 5 interviews with consortium members of a garden data ecosystem currently in development around a citizen science initiative in Flanders, Belgium. We discovered that the explicit use of values and frictions has the potential to augment the collaboration between actors. This approach can thus be useful to future practitioners who aim to expand the societal impact of their work.

## CCS CONCEPTS

• **Human-centered computing**; • **Collaborative and social computing**; • **Empirical studies in collaborative and social computing**;

## KEYWORDS

Citizen science, data-driven collaboration, data platform, values, data ecosystem, reflective participatory design

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## 1 INTRODUCTION

In recent years, there has been a rapid growth of research adopting a ‘data ecosystem’ perspective to study the human and technological aspects that lead to new value from data-driven activities in domains such as health, mobility, public administration [33, 34]. We define data ecosystems as socio-technical systems of actors, interactions and infrastructures collaborating towards the shared goal to create value from the data produced and used in specific domains [17, 18]. Typically, an actor can be an individual person or a community [46], an organization [13], a government entity [40], a company [37] or a non-human entity [29] which performs activities involving data to achieve a specific goal. Interactions are seen as collaboration between actors with shared or similar goals, while the infrastructures represent the technological aspects such as platforms, software, apps together with organizational, cultural and social aspects linked to the context in which data is used and produced [17, 18].

It is known that data ecosystems create opportunities for data-driven engagement between society actors through situated learning experiences as well as forming communities around topics that people care about [30]. Moreover, data ecosystems foster partnerships between research and industry as well as provide private and public actors socio-technical infrastructures for innovation [45]. However, data ecosystems are yet to be improved regarding how data-driven interactions and more specifically collaboration between actors are facilitated [8, 44]. Previous research showed that not enough attention is given to the values considered important, negotiated and promoted by actors in data-driven collaboration [19, 26, 41].

As such, this paper examines data-driven collaboration from a humanist perspective by investigating the ecosystems and communities in which data is produced and used. Such processes of collaboration between diverse actor groups, domains and disciplines are often guided by values [9]. Value or values, are approached by this study as something important for an actor and which implies a desirable behavior [38]. Values are tied to goals, objectives, motivations in making decisions and acting [36]. Since values are grounded in practice as beliefs, visions, motivations and conflicts, they can unravel how the socio-cultural, economic, technological and environmental dimensions can be better integrated for systemic

change [12]. Reflecting on the systemic nature of values, previous research on urban governance [42] and multispecies cohabitation in cities [43] addresses values as political, academic, technological and urban forms of more-than human inclusion that challenge and go beyond prevalent Western anthropocentric, capitalocentric and technocentric approaches to societal problems.

To contextualize the interaction between human and non-human actors in urban socio-technical systems, data is for its narrative power to contribute to collaborative meaning-making of complex environmental issues such as (loss of) biodiversity [7, 10]. Moreover, actors use data to connect objective knowledge about the environment such as air quality data to their subjective experiences and help bring forward implicit values that drive scientific work [25].

In order to address the gap in knowledge regarding data-driven collaboration between actors in data ecosystems, we propose the following research questions: *What role do values play in the process of developing a garden data ecosystem? And how can value-led participatory design support data-driven collaboration?* To answer these questions, we conduct a case study on a citizen science initiative called Mijn Tuinlab (MTL), in the region Flanders, Belgium. This investigation represents the exploratory phase of an ongoing participatory design study done in collaboration between the first author and the initiators MTL and we take the opportunity to reflect on the reality of negotiation, facilitation and conflict resolution within their initiative.

## 2 RELATED WORK

### 2.1 Multi-disciplinary collaboration in garden research

Private gardens are currently not part of regional and local policies of spatial planning in Belgium on topics of environment, rural development and social inclusion although they provide benefits in terms of food, shelter, air and water quality, space for social interactions, often to the expense of natural and agricultural landscape [4]. As a relatively new research topic, investigating private gardens involves the collaboration between many academic disciplines as well as other societal actors, as it creates the need for an open discussion space where values are made explicit and apparent. To address the issue of interdisciplinary and interdomain collaboration on the topic of private gardens, the citizen science initiative MTL was developed. It also came as a response to a growing need to advance private garden research - a relatively new study area in Flanders for biodiversity and sustainability, as private gardens represent a large, but very segmented portion of mostly residential territory [4].

Previous work facilitated by the MTL initiative implicitly reflect on: promoting principles (and values) of open science and responsible research by empowering people to make informed decisions based on scientific evidence [16]. Similarly, another study reflected on the impact of gardening as nurturing a relationship with one's gardens on physical and mental health [23].

### 2.2 Values in collaborations facilitated by participatory design approaches

*2.2.1 Values in participatory design.* In data-driven collaboration, values appear as personal, cultural or professional aspects that drive

decision-making and they can manifest as both individual or group values. Co-creative spaces such as living labs are one example of value-led and often data-driven partnerships that bring together citizens, public and private organizations to tackle wicked problems through real-life scenario building, exploration and negotiation [12]. Living labs put forward a societal challenge and engage citizens to collaborate with researchers, experts and practitioners to create solutions while at the same time build and sustain a community based on shared interests, values, motivations [31] and engage in learning and skills building [33, 34].

Moreover, multi-stakeholder collaboration is supported through participatory design by encouraging people to share how values are being grounded in practice, while emphasizing the role and positioning of the designer [14]. Moreover, value discovery is analyzed using empirical methods which allow designers to elicit reflections on values and value transfer – the links between values, requirements and arguments that support them in design processes [22, 23].

*2.2.2 Values in critical and reflective design.* The approach of reflective design [39] brings a critical theory layer of reflection on unconscious choices [24] and implicit values [9] in participatory design and collaboration. Critical reflection is supported and structured by participatory design approaches such as the one proposed by Frauenberger and colleagues [11] composed of four lenses – epistemology, values, stakeholders and outcomes (italics by original authors). This approach aims to promote rigor and accountability through all stages of the research process, from initially planning through reflection on and during work as well as shaping a well-rounded contribution to the field.

Moreover, previous work on the topic of agonistic design practices brings participatory design to the political realm [5, 6, 20] by highlighting the tensions and conflicts between competing values. Furthermore, agonistic speculative design is used as an approach to foster collaborative and participatory practices in communities which challenge techno-optimistic assumptions by negotiating values to better describe and contextualize preferable futures [1].

*2.2.3 Values in critical data visualization.* When values in data-driven collaboration are approached by data visualization studies, they advocate for a more humane representation of data in order to support a more intimate connection between people and data by helping them become aware of its context [27]. From a socio-technical systems perspective, because data representations are shaped by and in turn shape social, cultural and economic dimensions of society, critical design choices in data representation emphasize systemic oppression and support new power dynamics between marginalized communities and those who traditionally hold power in society [16]. Moreover, as they are part of the collaboration process, data visualizations emphasize frictions support transparent communication and trust building between collaborators by contextualizing and bringing granularity to shared and conflicting views as well as expose underlying assumptions [35].

Finally, while the datafication of society has accentuated the promotion of mainstream Western values as universal, new research agendas propose to study the South as a complex entity where data activism can emerge through new data imaginaries [28]. Data activism is approached by research in feminist data studies which

**Table 1: Three members of the consortium were interviewed and based on their recommendation, two additional collaborators.**

Interview ID	Role	Organization	Expertise
I1	Consortium member	Academic researcher	Garden research
I2	Consortium member	NGO	Nature communication
I3	Consortium member	R&D division	Data science, computer science
I4	Research collaborator	Practice-based researcher	Garden research
I5	Expert collaborator	Regional government	Open Science research, communication and coordination

challenge existing hierarchical and binary classification systems by exposing hidden biases and subjectivity, as well as invisible labor done by underrepresented communities behind data representations typically considered objective and neutral [3, 4].

Building on the previous stances on values presented, in this paper we propose a grounded approach that acknowledges the range of values that exist in data-driven collaborations and explores diverse value interpretations belonging to actors in a data ecosystem. Rather than create an exhaustive list of values, we aim to encourage actors to openly and critically reflect on the role of (their) values in the process of data-driven collaboration.

### 3 METHOD

#### 3.1 Mijn Tuinlab as a citizen science initiative

The goal of Mijn Tuinlab (MTL), which translates to “my garden lab” from Flemish, is to support and promote scientific and participatory research about private gardens by developing and managing a data platform sharing the same name – MijnTuinlab.be as well as gradually engaging society actors in joining a garden data ecosystem. The MTL initiative ran initially between 2018-2020 through a first round of funding from the Flemish regional government and restarted its activity for 2023-2025 after a second round of similar funding.

At the moment where the first author began this study, in July 2022, the initiative main activity has been reduced to project-based work that supported scientists who continued to use the data platform as well as basic administration of the platform. This represented a unique opportunity to engage the consortium partners in an exploratory process of critical reflection on the outcomes of their initiative so far, future directions of development and various ways that other actors can be engaged to join MTL as soon as new funding is acquired.

#### 3.2 Data collection and analysis

We used a reflective participatory design approach [11] to guide consortium partners through critical reflection by focusing on the role played by values in their initiative development. We engaged in a reflective practice since the beginning of a study in order to clarify starting intentions or potential misunderstandings with their collaborators at a moment where strategic changes can be easily made. As such, we invited several consortium members and collaborators of MTL to describe the MTL data initiative in terms of its goals, expected outcomes, organization type, actors involved and their roles. The discussions were based on

five interviews conducted by the first author with actors according to their role in the initiative, organization they represented and expertise, as presented in Table 1.

The participants have been selected based on their role in the initiative, following a snowballing approach based on other participants’ nominations until we reached saturation regarding our goal for this initial exploratory phase. The interviews were semi-structured based on the two main dimensions of values and stakeholders from the reflective approach of Frauenberger and colleagues [11] which resulted in the questions presented in Table 2. The interviewer did not always ask these questions directly, but mostly aimed to engage the participants in a critical reflection that followed the flow of the discussion and invited them to illustrate their ideas with examples or short stories. Generally, the interviewer also aimed to provide a safe space for storytelling where participants could present their work so far within Mijn Tuinlab in the context of similar citizen science initiatives and participatory processes. Similarly, while the participants have been made aware of the focus on values of the interviews, we did not intend to ask them to think of values directly, but to arrive at issues related to values by reflecting on the work process they have been a part of and the priorities they considered for decision making.

The interviews were conducted in English, had a duration ranging from 45 minutes to one hour, were audio recorded with the explicit permission of the participants and later transcribed. Using the structure of the reflective participatory design approach [11], the first author coded the transcripts used as primary data source for emerging themes according to a thematic analysis approach [2]. Project documents made available by the initiative as well as the first researcher’s notes and informal discussions with consortium members provided additional context for interpreting the themes in order to minimize bias, as multiple coders were not involved in the data analysis process. Additionally, the themes were presented, discussed and refined with the consortium members during the analysis.

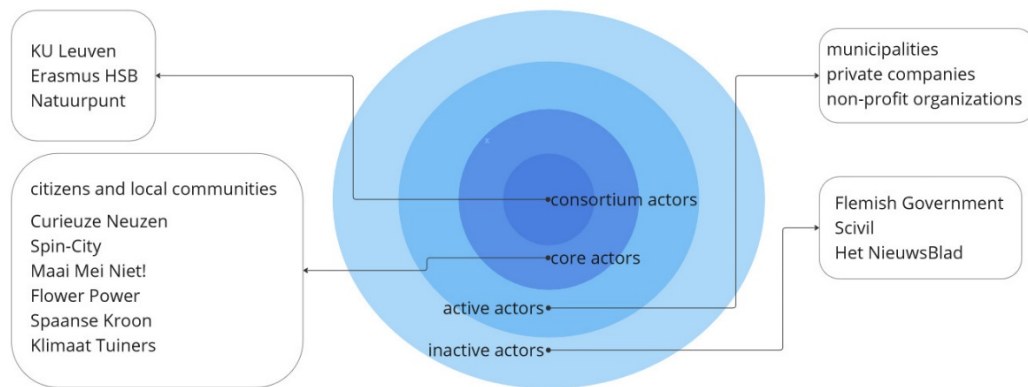
## 4 FINDINGS

### 4.1 Role(s) of values to support a developing data ecosystem

Figure 1 presents an ecosystem map depicting the actors part of the data ecosystem around MTL, grouped based on their role and agency in the initiative, according to a participation onion diagram [9]. This overview shows the different domains represented in the MTL initiative – academia, local government, NGOs, industry,

**Table 2: The guiding questions have followed two aspects of collaborative processes – actors and values, according to the reflective PD conceptual framework by Frauenberger and colleagues [11].**

Actors	Values
Who are the actors?	Which values drive the process? Are they explicit or implicit?
What is their role?	What conflicts arise from values?
How do they interact with other actors?	How do values change in the process?
How do they benefit?	How do values drive decision-making?



**Figure 1: Actors grouped according to role and agency in the initiative**

citizens and local communities and announces the values identified by this study: scientific integrity, public awareness & education, flexibility, openness, inclusivity, safety. We present them in detail in the following sections.

**4.1.1 Values of scientific integrity and public awareness & education as two distinct project objectives.** From the official communication and project documents we learned that the main objective of the initiative is to map the composition of private gardens with help from citizens by following the value of scientific integrity. Moreover, during interviews another objective was stressed to us: to raise awareness among citizens about the importance of private gardens in relation to biodiversity and to educate them about scientific research. These two values of scientific integrity and public awareness & education coexisted from the beginning lead to a project having two separate objectives which were not clearly communicated between and to the actors and challenged collaboration.

“We saw that universities were also interested in this field [...] also garden architects and landscape designers[...]. And we shared the idea that we don’t only want to collect data and do science, but also want to motivate people to change.” – I2

**4.1.2 Value of flexibility grounded as a platform functionality.** To achieve the scientific integrity objective presented above, citizens

have been invited (via the user interface of the Mijntuinlab.be platform) to create a profile based on the characteristics of their garden; as a result, a garden score that reflects biodiversity was calculated based on parameters including surface, orientation, types of plants and insects observed. In the backend, the platform was designed to be flexible so that research initiatives with similar goals to be able to combine their studies on private gardens. However, while flexibility is valued by many actors especially the ones representing academia and leads the entire development process of the data platform, it is often treated as an implicit part of the project rather than stated as a priority from the beginning:

“Sometimes the scientists can do it [collect data] by themselves, but they want the interaction with the people and grounding their research in society to be more connected to society or to teach society about the research.” – I5

**4.1.3 Value of openness seen as a strategic vision.** With a new round of funding received, the consortium aimed to open the initiative to a wider set of actors from researchers, the civil society, citizens to municipalities, public and private organizations around their platform. This strategy helped to create systemic impact by not only strengthening individual research initiatives, but helping local communities to bring evidence to support claims on local issues:

“The grassroots initiatives that go ask help [to set up a citizen science initiative], they want infrastructure and to be heard and to be recognized that what they measure is valid [therefore] the municipality will do something with it.”- I5

**4.1.4 Value of inclusivity as ongoing and recurrent topic for improvement.** As the second phase of the project is about to kick off, the project initiators are collaborating with the connected research projects to improve and build the initiative in a systematic process. One issue to be addressed is making the platform more inclusive to groups who were previously neglected:

“[We have] a group of people who are collaborating, but we know that they’re really into this kind of stuff ‘ cause they already subscribe to the projects. Most of them are doing some ecological gardening. They are a very small subgroup of the Flemish population so we really need to expand this group or at least the group that we want to communicate to.”- I4

Although it is not communicated as a strategic objective or vision, the value of inclusivity was mentioned regarding ways to improve the data platform functionalities to cater to different types of user groups and access levels to scientific research data.

**4.1.5 Value of safety as a data collaboration protocol.** We also discovered that mismatched data formats and data uses as well as cumbersome collaboration policies between research institutions can create tensions and hinder collaboration. These tensions are linked to the different organizational values that come together in the MTL ecosystem which are often implicit, but seem to clash when issues regarding platform development appear:

“We’re all from different institutions and then it then it gets difficult. It would be [great to] share the data.[...]You need kind of a protocol to be sure that on one hand you can collaborate, but on the other hand that you are safe and know that you’re not giving away.”- I4

## 4.2 Values that support data-driven collaboration

**4.2.1 Changing values that are shaping the initiative: public awareness & education evolved towards community building.** Values play a role in shaping the initiative vision and development from the beginning both implicitly and explicitly: in project documents, the initiators communicate that the societal impact created consists of bringing awareness among citizens of the role that private gardens play for mental and physical wellbeing, for social connection, but also for addressing climate change. Their approach is seen by other actors implicitly as a path to exchange and share values:

“And that’s the good thing about citizen science, that you look at individual people and try to give them some of your values, things that you value most. I think it’s the easiest level [of impact] perhaps.”- I4

However, during discussions the actors interviewed have reflected on the changing nature of values once the initiative took off. They mentioned that, the initial focus on supporting citizens to build

knowledge and skills in working with scientific data has evolved towards building a community of actors who help each other tackle complex problems

“[We aim to] invest in the community feeling by providing feedback on research results. So that that’s lacking for the moment, because the goal is to get this society and this community feeling because we want to engage people to collaborate.” – I2

**4.2.2 Values that steer decision-making and strategy: communication, open science, transparency and accountability.** Values also serve as criteria for choosing collaborators among the scientific community with shared interests, goals and work strategies; initiatives that want to use the data platform should be interested in scientific research, contribution to research, to nature protection, to ethical considerations of trust and transparency:

“Any initiative can use the data platform, if it’s purely collecting data for economic reasons or something, then we do not accept it. First of all it should be scientific basis and also it should match our sustainability philosophy.”- I2

During the reflections facilitated by the interviews, we noticed that decision making is also driven by values, for example the type of funding chosen. More specifically, regional government funds for citizen science require that the principles of open science, transparency and accountability are prioritized. Moreover, the actors interviewed have reflection on misalignment of values: when values are not clearly communicated among various actors, a misalignment of expectations is created which can sabotage a potential partnership:

“The problem with private companies often is that they see [citizen science] more as a promotion stunt while it doesn’t have to be that way, if [they] do valid citizen science research and they communicate very openly about how they did it and about the results and why. Emphasis [on the fact] that it has to be genuine. It has to be authentic if you want to do citizen science.”- I5

Finally, during discussions prompted by the stakeholder and values lenses, it became clear that transparent communication with citizens is a value that steers the process for research projects who collaborate through Mijn Tuinlab:

“So citizens are our [main] stakeholders. We also have a steering committee which consists of people from the [regional] government, people from the university, [as well as] city Green services. Different people have experience as well with nature conservation management and they advise us on the one hand to the for the practical side, but then also how to communicate with citizens.” – I4

## 5 DISCUSSION AND RECOMMENDATIONS

### 5.1 Facilitating the explicit use of values to support decision-making

Reflecting on values helps actors make objectives and strategy explicit, and helps them find common ground with other actors. Even though reflecting on the role of values initially seemed a challenging, but approachable task for the actors interviewed it became apparent to them that there are topics such as flexibility, openness, transparency connected to it left unchecked or implicit within the consortium and with the other actors involved. However, the interviews provided a space to brainstorm new ideas that were kept implicit before:

“[Mijn Tuinlab could be a] portal or mental map for garden professionals where get spatial information about the neighborhood, about relation to natural areas, climate risks that are present. And now I'm thinking of flood or dealing with biodiversity values. That could be a [...] better foundation for their designs, research based and not based on assumptions.”-13.

This is in line with previous research that reveals how different conceptualizations about the shared work in living labs leading to unmet expectations can be mitigated by making values explicit [9]. Literature on value-led participatory design approaches with communities explains how to better support values to emerge, develop and become grounded in practice [14, 15, 23].

### 5.2 Bringing to surface frictions and conflicts to improve collaboration

While values have been initially conceptualized during interviews as ideals, common beliefs, a shared vision towards societal and scientific goals, the discussions served also as a reflection tool to identify when values were not aligned, or even created frictions between different ways of working with data, different institutional policies or different worldviews. Such frictions were identified in previous research on innovation ecosystems and co-creation [31, 32] as well as data-driven collaboration [8, 35]. In previous work we find approaches where designers integrated values were integrated in collaborative processes by aligning them to ethical aspects, supporting their emergence and grounding in participatory processes and using them as support for voicing diverging views and co-creating shared visions [1, 20, 21].

## 6 CONCLUSION

We presented the case study of a citizen science initiative built around a data platform that aims to develop an ecosystem of actors around private garden research through participation and collaboration. Based on reflective interviews with consortium members we provided a rich contextual account onto two aspects relevant for a critical participatory design approach: collaboration between actors and the role of values in facilitating and enriching it.

While values seem to constantly shift on the priority list as the initiative progresses, they do provide a constant structure that

guides decision-making, and goals-setting among the actors. However, communicating and negotiating values is not always straightforward among collaborators and participatory designers in their role of facilitators can provide help by:

- Facilitating the explicit use of values by actors to align and confirm shared expectations and
- Bringing to surface frictions and tensions when such expectations are mismatched to continue dialogue and find common ground.

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