

Global goals, local future stories: unpacking contrasts and visions of circular economy activities in neighbourhood circular makerspaces

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Circular makerspaces have the potential to contribute to sustainable development goals (SDGs) by promoting circular-making activities such as reusing, repairing, refurbishing, and recycling. However, community building is essential for maintaining a circular makerspace, which requires engaging the makers and future users in circular-making activities. In this paper, we argue that involving locals in the design of circular makerspaces can facilitate community building and support makers' sense of belonging to the space. We present the experience of involving citizens in establishing circular makerspaces in seven European cities as part of the EU-funded H2020 project, Pop-Machina. We developed a technique, called the Local Future Stories (LFS) to gather the values, visions, and dreams of local communities that may potentially support community building and engagement around circular makerspaces in Leuven, Venlo, Kaunas, Santander, İstanbul, Thessaloniki, and Pireaus. In this paper, we present citizen-driven values and visions from these cities around circular makerspaces and reflect on LFS's potential to bridge top-down and bottom-up knowledge into project framing in multi-stakeholder international projects. Our work makes two contributions to the literature: presenting LFS as a new technique to collect citizens' values and visions into circular makerspaces and presenting citizen-driven values and visions which would inspire other European cities to establish new circular makerspaces.

Keywords: *makerspaces; circular economy; futures; local future stories*

1 Introduction

Grassroots organizations and communities can contribute to a transition towards a circular economy by engaging citizens in sharing, repairing and reusing products as well as recycling materials. These places include repair cafes and precious plastic spaces (Spekkink et al., 2022), and makerspaces (Prendeville et al., 2017). Circular makerspaces enable the performance of circular-making activities such as reusing, repairing, refurbishing, recycling, etc. These places can contribute to sustainable



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development goals (SDGs) by reducing CO2 emissions through localized production and transportation of goods (SDG 12), alleviating inequality and exclusion (SDG 10) (Roldan et al., 2018) raising makers' awareness about the circular economy (SDG 11) empowering citizens to increase their impact on sustainability transitions (SDG8) (Coskun et al., 2022).

Makerspaces are organized around creating knowledge and physical or digital products (Martinez & Stager, 2013). They allow makers from diverse backgrounds to interact with each other, learn from each other and collaborate in making projects (Einarsson & Hertzum, 2021), which in turn helps build a community (Kohtala & Bosqué, 2014). This community-building aspect is highly essential for maintaining a makerspace since tools supporting fabrication activities become meaningless without an engaged community of makers. Previously, several suggestions have been made to help engage the community around a makerspace such as engaging students, using social media channels, organizing maker fairs, or creating a pool of maker mentors (Oliver, 2016). In this paper, we argue that an alternative way to facilitate community building around a circular makerspace and support makers' sense of belonging to this space is involving the future users in its design.

Within the scope of Pop-Machina, we had a first-hand experience involving citizens in establishing circular makerspaces in seven European cities, which we refer to as city pilots. This EU-funded H2020 project seeks to demonstrate the maker movement's potential to promote the circular economy (CE). Building through a set of circular-making activities held in makerspaces across Europe, the project explores how to reinforce the links between the maker movement and the CE to promote environmental sustainability and generate socio-economic benefits.

Pop-Machina is inherently a multi-stakeholder project, as it includes local governments, universities, consultancies, makers, and the public. The project has four visions pertaining to CE which were determined by the project team by referring to existing European policies about circular economy. These are social cohesion, urban transformation, sustainable and circular production. Besides these project-wide horizontal priorities, each city had its priorities set upon the participation of makers, city representatives, and local project partners. Thus, the project includes a diverse array of interests, perceptions, and values associated with the maker movement and CE.

To address this diversity within the scope of designing the circular makerspaces, we decided to co-design circular activities in each pilot city with relevant stakeholders including citizens, makers, NGOs, and local governmental actors. Large-scale projects have a prevalent challenge in terms of sustaining the achievements over time (Saad-Sulonen et al., 2018) and integrating residents' views and visions into the scope and goals of the projects (C Smith et al., 2020; Oostveen & den Besselaar, 2004). Hence, we approached the pilot activity design with a participatory and speculative lens (Akama et al., 2016; Bardzell, 2018a; Dunne & Raby, 2013) supporting citizens to imagine how life in a neighbourhood equipped with a circular makerspace could be and what kind of activities they wished this place could facilitate.

As a first step of this co-design task, we conducted Local Future Stories (LFS) to gather the values, visions, and dreams of local communities that may potentially support community building and engagement around circular makerspaces in pilot cities, as well as integrate these into the project's

framing. LFS asked the public to reimagine their everyday life in a circular maker neighbourhood, that is, a future in which each neighbourhood has a makerspace equipped to carry out circular-making activities. By analysing and learning from these stories with the local governments, we were able to identify values and envisioned goals relevant to bridge the goals of the project with the collective imagination and dreams about each city's circular makerspace.

This paper examines how to integrate the priorities, visions, and values of local stakeholders into general CE values in a multi-stakeholder European-level project, an area that has not yet been thoroughly researched (Hobson, 2016; Merli et al., 2018). With this work, we make two contributions to the literature. First, we present LFS as a new technique to collect citizens' values and visions into circular makerspaces along with our reflections on using it within the scope of Pop-Machina. Second, we present citizen-driven values and visions from seven European cities around circular makerspaces. With all the above, we reflect on and discuss LFS's potential to bridge top-down and bottom-up knowledge into project framing in multi-stakeholder international projects.

2 Background

2.1 The project

Pop-Machina is a Horizon 2020 project aimed at promoting environmental sustainability and generating socio-economic benefits in European cities by highlighting and reinforcing the links between the maker movement and the circular economy. The circular economy is a concept that offers a viable alternative to the current linear production and consumption models that produce a significant amount of waste and have a devastating environmental impact (MacArthur, 2013). By embracing the circular use of materials, such as recycling and reusing, we can reduce waste generation and minimize our reliance on raw materials. This approach has immense potential to bring about substantial economic and environmental advantages. The maker movement is a community of do-it-yourself enthusiasts who create innovative products from waste materials or repurpose items that are discarded or no longer in use (Kohtala, 2015). The growth of makerspaces, affordable digital fabrication tools, and the prosumer trend has propelled the maker movement, sparking creative communities across the globe.

The project seeks to demonstrate the potential of the maker movement and collaborative production for the EU circular economy, contribute to the growth of maker ecosystems and the production of circular innovations in European cities, support the implementation of the EU Circular Economy Action Plan, mobilize citizens under the banner of circular economy and collaborative production, and empower communities to innovate and make their cities more resilient and adaptive to socio-economic and environmental challenges. The project is a collaboration between 23 partner institutions, and it is being piloted in seven cities, namely Leuven, Venlo, Istanbul, Santander, Thessaloniki, Piraeus, and Kaunas.

One key goal of Pop-Machina is to mobilize citizens under the banner of circular economy and collaborative production, empowering communities to innovate and make their cities more resilient and adaptive to socio-economic and environmental challenges. To achieve this, Pop-Machina engages

existing makers and citizens as circular makers in pilot cities. The project recognizes that the maker movement currently lacks diversity, and as such, is emphasizing the engagement of citizens to become members of the Circular Maker Movement (CMM). Through its inclusive engagement strategies, Pop-Machina seeks to achieve its goals while promoting social and environmental justice. The technique we propose in this paper is one of these strategies and it serves the purpose of integrating citizen values and visions into circular makerspaces.

2.2 Future studies and speculative design

Future studies and speculative design focus on exploring the social, cultural, and ethical implications of emerging technologies and future scenarios (Baumann et al., 2017; Hancock & Bezold, 1994). It uses different methods and techniques to create ideas and prototypes of future artifacts, services, and systems that challenge our assumptions and preconceptions about the future (Blythe & Wright, 2006; Candy, 2019; Ramirez Galleguillos et al., 2022). The exploration of futures often involves creating intentional, provocative, or just absurd scenarios to promote debate and reflection. These scenarios can help individuals imagine alternative futures and raise questions about the impact of an intended technology, product, or service on society, the environment, and human values (Gidley et al., 2009; Törnroth et al., 2022).

Some of the methods used in speculative design include scenario building (i.e., building involves creating plausible and compelling stories about possible futures), critical design (i.e., creating objects or artifacts that challenge our assumptions about design and its role in society), and design fiction (i.e., using storytelling and fictional narratives to explore possible futures and their implications) (Bardzell, 2018b; Blythe & Wright, 2006; Muller et al., 2020). When these techniques are used with individuals experiencing a specific reality it is used as material to understand their thoughts about the future. This approach, referred to as Participatory Futures (Ollenburg, 2019), has been applied in including relevant participants in envisioning futures of human rights (Astrid Mendez Gonzalez et al., 2020), data and privacy (Shklovski & Grönvall, 2020), and urban technologies (Baumann et al., 2017). In this study we present the results of Local Future Stories as a participatory futures activity to collect the visions and values of citizens about future circular makerspaces during COVID.

3 Methodology

3.1 Local future stories collection

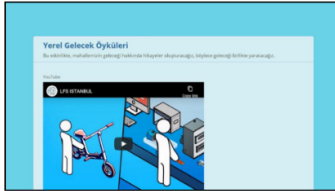
From August to October 2020, the seven cities involved in the project collaborated to gather Local Future Stories to uncover citizens' visions and values concerning a future local circular maker space. Due to COVID-19 social distancing restrictions, the activity was carried out remotely. The authors created a web page for each city to gather stories in their own language, and the initiative was promoted through the municipalities' websites, newsletters, and social media channels.

During the activity, citizens were encouraged to use a future-oriented perspective to create stories that envisioned what their daily lives would look like if they resided in a circular neighbourhood - one that included a makerspace equipped for circular-making activities such as repairing and creating discarded materials (i.e., a circular makerspace).

Local Future Story Collection Steps

1. Video introduction

The participants watched a short video to introduce the project and trigger of a speculative and creative mindset.



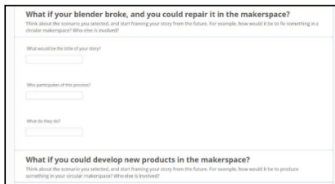
2. Scenario selection

Participants choose one topic out of eight available to create their story. The topics were: **producing, repairing, training, creating value with biological waste, community life, sharing, makerspace's sustainability and collection of materials.**



3. Story creation

Participants created their story of the future by stating a title, who participated in the story, what they did in the story.



4. Change proposition

Participants were asked to answer two questions about what it needed to change today to reach the future they mentioned in their story and how that change should be approached.

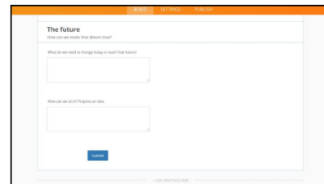


Figure 1. Local Future Stories stages summary

The activity was divided into four stages (Figure 1). First participants watched a brief video that introduced the project and encouraged a speculative mindset (Dunne & Raby, 2013). Second, they were prompted to select one of eight scenarios that reflected potential activities that could take place within the circular makerspace of their neighbourhood. We developed these scenarios in accordance with the Maker Manifesto and align them with the values of the Circular Economy. The scenarios included actions such as producing, repairing, training, creating from biological waste, promoting community life, sharing, improving the circular makerspace's sustainability, and collecting discarded material. Each scenario was introduced and explained (Figure 2) to have a shared understanding. Third, participants were asked to craft a story about the future taking place in this hypothetical circular makerspace. Finally, they envisioned a change proposition, stating what would need to change today to reach the vision outlined in their story in the future.

3.1.1 Exemplar story 1 (Istanbul):

People can turn the items left in a centre in the neighbourhoods and are idle and buy them into materials they can use. From time to time, students such as technical trips from schools can come to these workshops, do practices such as business technical lessons and buy what they produce themselves or open an exhibition in their schools. For example, a children's play kitchen can be created from an idle TV stand and delivered to a kindergarten or similar institution in the region.

3.1.2 Exemplar story 2 (Thessaloniki):

Headphones break down often. Either internally, or external damage is created, or their casing breaks. The latter happened in this case, and we decided after a meeting with the neighbour to visit the makerspace to make a piece of plastic in the dimensions needed to place it in the broken spot. We found the plastic we wanted, the right machine to cut exactly as we wanted, and glued it to the broken headphones. My headphones are like new now!

Local Future Story Scenarios



Material collection

Your neighbourhood's makerspace needs plastic bottles and electronic waste as materials for fixing already existing products (for example broken mobile phones) and producing new ones. As a community member, you want to support this material collection activity in your neighborhood. .



Repairing

Your blender is broken, and your neighbor suggested you should go to the neighbourhood's makerspace and repair it.



Value from biological waste

You want to grow some vegetables using biological waste. You use the composting facility of your local makerspace.



Producing

You have an idea for a new product (for example a new chair) that you can create in your neighbourhood's makerspace by using discarded materials.



Sharing

You need a drill to fix your broken chair, but you do not have one. Then, you remember the makerspace offers borrowing certain equipment for fixing different things. You want to borrow a drill from the makerspace.



Makerspace's sustainability

The makerspace needs regular cleaning and organization to keep the space and equipment available to the neighbors. As you want the makerspace to keep running, you are organizing the maintenance activities this week.



Training

You heard that there will be training workshops about repairing products and reusing discarded materials in your neighbourhood's makerspace. You want to take this training.



Community life

The neighbors are proposing new activities for the community in the makerspace. As a community member, you have an idea to increase the participation of children, older people, or women in this makerspace.

Figure 2. Exemplar scenarios referring to each action potentially being developed in the local circular makerspace.

3.2 Analysis

Once the stories had been collected, the local governments were invited to assess them based on several parameters, including the level of innovation, the quality of the content, the relevance to the city's priorities, and the relation to the city's CE context. These criteria were proposed to help understand which stories were possible in futures (Hancock & Bezold, 1994). We also asked the cities (i.e., the team managing the local pilots that includes representatives from the local government) to provide insights into what they had learned about the residents' aspirations and values regarding the circular makerspace. Additionally, we requested that the local governments translate the stories so that they could be analysed in English.

Next, we conducted a thematic analysis (Braun & Clarke, 2020; Clarke & Braun, 2014) of the stories, which involved coding them by creating clusters of topics addressed, identifying patterns, and

exploring connections between themes. In this paper, we introduce the findings concerning the themes of visions and values found in the stories.

4 Results

In this section, we first present the citizen-driven circular makerspace stories from the pilot cities. This will include an overview of the themes and a comparison between stories created in each city. Then, we present the five circular makerspace visions identified based on these stories.

4.1 Local future stories into circular makerspaces

Through the LFS technique, 131 stories were collected in seven pilot cities. Overall, it was observed that the most popular topics covered in the stories were community life (29), sharing (23), producing (21) and repairing (18). The least popular topics were the circular makerspace sustainability (7), the use of biological waste (9), training (12) and material collection (12) (Table 1). These results imply that participants perceive community life, sharing, producing, and repairing as more plausible in the context of a circular makerspace. An alternative interpretation of these results could be citizens creating the stories are more knowledgeable about community life, sharing, producing, and repairing, and less knowledgeable about other categories.

Table 1 The number of Local future stories collected in each pilot city.

	Istanbul	Kaunas	Leuven	Piraeus	Santander	Thessaloniki	Venlo	Total
Repairing	3	3	2	2	4	1	3	18
Producing	8	1	1	1	2	5	3	21
Biological waste	3	2	1	0	1	1	1	9
Training	3	2	1	2	2	1	1	12
Community life	15	2	7	1	2	1	1	29
Material Collection	4	2	1	1	2	1	1	12
Makerspace sustainability	3	0	1	0	2	1	0	7
Sharing	10	1	6	1	2	1	2	23
Total	49	13	20	8	17	12	12	131

We observed some differences in terms of the most selected topic in the cities. Looking at the stories city by city, Istanbul has most of the stories created. This is expected considering the size of the city. The 49 stories Istanbul citizens created are focused on community life, sharing, and producing. In line with this, Istanbul participants associated the circular makerspace as a socialisation and cooperation

space where an inclusive community of women, the elderly and children share gardens and spaces along with tools, materials, and knowledge. The less selected topics for Istanbul were the circular makerspace sustainability, along with repairing, training, and the use of biological waste. In Leuven, the most popular topic was community life and sharing. Leuven participants see the circular makerspace as a social environment like a cafe where citizens from various backgrounds including children and youth make together, create with their hands, and as a library offering knowledge beyond books. All the other topics were not prominent in Leuven's stories.

In Santander and Kaunas, different from Istanbul and Leuven, the most popular topic was repairing. Furthermore, the distribution of the stories is more even compared to other cities. This implies that Santander citizens have a diverse array of expectations from a circular makerspace. People in Kaunas and Santander envision a circular makerspace where the community can collect waste material from the city, build together, and repair together as well as a place to support local makers' businesses. In Kaunas, the circular makerspace sustainability was not represented in any story.

In Thessaloniki, the most popular topic was producing. Similarly, in Venlo, the most popular topics were repairing and producing. Although stories from these two cities prioritise production, they also have components related to community building and social aspects. In both cities, citizens envision the circular makerspace as a social and inclusive place where all the citizens, including the unemployed and children, can make together. Different from Thessaloniki, Venlo's stories also emphasise the importance of volunteer work, and sharing tools and knowledge. Plus, In Venlo, the circular makerspace sustainability was not represented in any story.

In Piraeus, the most popular topics were repairing and training. While stories emphasise the importance of social inclusion in collaborative production, the learning component was quite prominent compared to other cities. Finally, in Piraeus, the circular makerspace sustainability and biological waste were not represented in any story.

4.2 Visions for circular makerspaces

Local Future Stories was conducted as a way to reach citizens' dreams and imaginaries about how a circular makerspace would be in a near future scenario. With these imaginaries, we would be able to access what the citizens value and expect from such a place in the context of Pop-Machina. After collecting and analysing the stories along with participants' change propositions, we have framed the following visions of the circular makerspace.

4.2.1 The circular makerspace as a social place

The stories in all the cities included a perception of the circular makerspace as a place to socialise, create networks, build communities, and generate support among neighbours. In this sense, there is an expectation in terms of the opportunities provided by the circular makerspace to build relationships and get to know others around. Therefore, suggested that activities in the circular makerspace could provide a ground for, on the one hand, just meeting with others and feeling heard or even just spending time together, and, on the other, community building where participants can organise activities, participate and feel as an important part of the place. These recommendations touch upon

activities but also the design of the circular makerspace, as there need to be spaces where people can spend time beyond maker activities such as cafes.

4.2.2 The circular makerspace as an inclusive place

In every city, we were able to find special focus in terms of perceived unprivileged groups the circular makerspace could benefit from, hence highlighting the significance of conducting activities specially created for these groups to be part of the maker community. These activities were not observed as only targeting unprivileged groups but explain the efforts that need to be put into thinking how to reach them, how to invite them, and how to support their participation. Within the scope of collected stories, the unprivileged groups were seniors, unemployed, children and women. The stories suggested that the place and design of the circular makerspace again should consider how inclusive and accessible it is for these groups in terms of territory as well as how usable can be the equipment for people with various levels of dexterity, body strength, skills, and knowledge, among others. Furthermore, they implied that activities that will be carried out should focus on providing unprivileged groups with an opportunity to develop their skills.

4.2.3 The circular makerspace as sharing place

Likewise socialising and including unprivileged groups, citizens envisioned a circular makerspace as a place where people can share equipment, materials, artefacts (i.e., white appliances) and knowledge. Many stories suggested the idea of having a space in the circular makerspace where various products can be easily accessed and borrowed by the participants who could not access them normally, for example, a juicer or a drill. These are things that might not be used daily, therefore, for some families buying them would not be a necessity. Still, neighbours could benefit from having access to them when in need and by this, save some money. Along with this, the stories suggested that knowledge should be shared, both technical knowledge and soft skills, either by having a platform where people can document and share their maker process so that others can take it as an example or by participants organising their own activities according to what they have knowledge about.

4.2.4 The circular makerspace as an economically supportive place

Most of the cities observe the circular makerspace as a place where they can be supported economically by, on one hand fixing broken things instead of buying new ones, accessing products as was mentioned in the previous section and, also, by creating new businesses. According to this idea, people perceive the opportunity to create with the support of others, who can be their neighbours or experts, and integrate these products into the market. Therefore, it is suggested that activities in circular makerspaces could focus on training people about circular businesses and product development as well as connecting them with investors.

4.2.5 The circular makerspace as a place to take care of local problems

As a last point, we have understood that the stories and imaginaries of what happens in the circular makerspace (i.e., projects created, materials used, groups of participants) are connected to each city's local context mentioning the issues they face daily, their concerns, but also their wishes for their city. Therefore, it was observed that participants envision the circular makerspace as a place where they can take action for the problems, they face to create solutions and organise themselves around topics that are related to education, environment, and inclusion. This implies that activities in circular

makerspaces need to be contextualised around the discarded materials and places of the city that participants believe to be more urgent to the cities. Furthermore, local governments need to support initiatives from neighbours that wish to contribute to solving a social problem. The latter means, providing support, guidance, and training on how to perform these projects.

5 Discussion

5.1 Visions about the Circular Makerspace

Through Local Future Stories we were able to access neighbours' dreams and imaginaries about how a circular makerspace would be. Our aim was to investigate what would they value and expect from this place to integrate such aspects into the pilot deployment. Therefore, with this activity, we have found that participants of the activity, associated circular makerspaces with a diverse set of values. They perceive a circular makerspace as a

1. A social place where they can socialise, create networks, build communities, and generate support among neighbours.
2. An inclusive place where unprivileged groups can become part of the maker movement to improve their everyday life.
3. A sharing place, where people can share equipment, materials, artefacts (i.e., white appliances), and knowledge.
4. An economically supportive place, where people can fix broken things instead of buying new, can access new products, and where they can create new businesses.
5. Finally, a place where they can take care of local problems collectively and contextually.

Makerspaces allow people to share knowledge, ideas, skills, and equipment by prioritizing sharing and learning over commercial benefits (Kuznetsov & Paulos, 2010; Peppler et al., 2016). These places also support community building ((Lindtner et al., 2014; Oliver, 2016). However, makerspaces have values beyond learning, sharing and community building. Makerspaces are social and inclusive spaces that support the well-being of their users (Taylor et al., 2016). While the values and visions we identified in this study are in line with this previous work (e.g., the circular makerspace as a social, inclusive, and sharing place), we have also identified two visions that were not prominent in previous work (e.g., the circular makerspace as an economically supportive place and a place for collectively solving local problems). Although the scenarios we introduced in the scenario selection step were retrieved from circular economy principles (e.g., repair), the participants seemed to be more interested in creating stories emphasizing the community aspects. In other words, we observed that the “circularity” aspect was not entirely visible in the identified values and visions. The small number of stories targeting material collection, utilization of waste, and circular makerspace sustainability is an indication of this observation (See Table 1). In future iterations of the technique, this issue can be addressed, for instance, by conducting an additional activity where the participants reiterate their stories with a lens of circular economy principles (i.e., asking how they envisioned the circular makerspace contributes to circular economy goals).

5.2 Reflections on the methodology

Large-scale and international projects have challenges to include local citizens in the framing of projects and determining their goals and objectives (C Smith et al., 2020; Devan Shah et al., 2020). We observed that LFS were useful to identify the visions and values of city residents concerning the circular makerspaces. Especially, they proved helpful in providing new knowledge to the local governments as all municipalities provided us with a set of lessons learned with this activity. These lessons are centred around new kinds of activities that could be performed on the circular makerspace that they did not consider before, representing a space with more potential than just making or producing, for instance for just socializing and sharing skills; the different uses that residents would give to such a space, the understanding of the residents about the CE and the maker movement, and most importantly the different aspects that residents would value of such a space if it existed. In other words, LFS served as a cost-effective tool helping one type of stakeholder (local governments) learn about other stakeholders (general public and makers) Hence, LFS could be proposed as a good practice to bridge the gap between top-down and bottom-up structures for projects aiming to engage residents and citizens into project framing.

The stories were collected during COVID-19 restrictions, which forced us to re-design the original in-person activity towards an online one. Therefore, we faced challenges related to promoting a similar level of creativity and reflection as it would have been in person (Bakırlıoğlu et al., 2020). We made use of videos and visuals to make the activity more engaging as well as making our best to collect stories through local governments. Collaboration between different stakeholders was key to collecting the number of stories and adapting the activity to cities with various levels of development of the maker movement and the circular economy, with different priorities and focuses concerning the stakeholder's goals and with different understandings of what these concepts represent. There were benefits of conducting the activity online, such as being able to carry even with social distance restrictions, run it for a longer time span than it would have been with a workshop, and give access to people that normally would not be able to attend to such in-person meeting for different reasons as not matching their schedules, not having the accessibility to the place between others. However, there are also drawbacks as not being able to represent people who do not have access to a computer and internet or the ones the open call did not reach. Nonetheless, the way in which the activity was carried out enabled us to collect interesting, creative, and divergent stories that represented alternative uses and alternative potentials for a circular makerspace the project did not consider before, and in so, the pressing constraints of COVID-19 directed us to find a solution that benefited us and made us understand that it is possible to have a similar quality level with activities conducted online and asynchronously.

Future studies and future-oriented research has proposed methods to explore alternative, potential, and possible futures (Hancock & Bezold, 1994). This field does not aim to predict one single future or a state but to aid in envisioning futures. However, more works have started to apply this method not to focus that much on the future, but to use the future as a prove to think about and design the present (Ramirez Galleguillos et al., 2022). In that sense, through this study, we also have learned about LFS's potential to promote the creativity needed to dream of alternative futures and then discuss that future in terms of the present. Hence this technique was helpful to identify spaces that researchers,

along with local governments, project stakeholders and residents, need to work on to walk towards those futures. With all the above, this activity allowed us to investigate current ideas and values that people have about circular makerspace that we could integrate into projects in the present, to impact the future. For instance, by discovering the relevance of socializing and sharing skills in different cities, we were able to collect ideas for activities that promote those values as it happened with the “skill directory” in which residents suggested we could have an inventory of skills of people in their neighbourhood so that they could share their knowledge, teach something, or just help each other in different personal or making projects.

5.3 Limitations

This exercise was initially planned to be carried out in a series of physical workshops. But, due to Covid-19 development, it was done remotely. Though the websites allow us to collect many stories, there may be communities whom we could not reach as they lack access to the internet or computing resources. Furthermore, the stories collected in each city are not generalizable to the entire city as we were able to get them from a small sample. Despite this, LFS's goal was to encourage participants' creative thinking to push initiatives for the pilot deployment first, followed by an activity that may aid in our understanding of the beliefs and ideals of the maker movement and the circular economy. Thus, the depth of an individual's dreams and inspiration for the activities of the deployment plan is key in this form of speculative and generative activity.

6 Conclusion

Circular makerspaces could facilitate cities' transitions to a circular economy by engaging citizens as makers. In such circular makerspaces, citizens can learn about the circular economy (secondary materials) and making (using a 3D printed part to repair a chair), having a direct contribution to circular-making activities performed in a city. Since a vibrant circular-making community is essential to maintain this contribution in the long term, these spaces should be developed by considering the needs of local stakeholders. In this paper, we proposed Local Future Stories as a technique to gather local citizens' values and visions about circular makerspaces, within the scope of a four-year EU project. By using this technique, we identified that, despite the differences in different cities, individuals see circular makerspaces as places for inclusion, socializing, sharing ideas, skills, and knowledge, creating, and supporting local businesses, and solving the problems of the community as a community. These values have been integrated into a new circular makerspace established within the scope of Pop-Machina. We hope that this broader perception of makerspaces will encourage other European cities to create new circular makerspaces to support community-driven circular innovations.

References

- Akama, Y., Keen, S., & West, P. (2016). Speculative design and heterogeneity in indigenous nation building. *DIS 2016 - Proceedings of the 2016 ACM Conference on Designing Interactive Systems: Fuse*, 895–899. <https://doi.org/10.1145/2901790.2901852>
- Astrid Mendez Gonzalez, P., Castaneda Mosquera, S., Paula Bernal Tinjaca, M., Mejía Sarmiento, R., Alejandro Morales Rubio, R., Camilo Giraldo Manrique, J., & Baquero Lozano, S. (2020). Participatory construction of futures for the defense of human rights. *ACM International Conference Proceeding Series*, 2, 10–16. <https://doi.org/10.1145/3384772.3385155>

- Bakırlioğlu, Y., Ramírez Galleguillos, M. L., & Coşkun, A. (2020). Dreaming of immersive interactions to navigate forced distributed collaboration during Covid-19. *Interactions*, 27(5), 20–21.
- Bardzell, S. (2018a). Utopias of participation: Feminism, design, and the futures. *ACM Transactions on Computer-Human Interaction*, 25(1), 1–24. <https://doi.org/10.1145/3127359>
- Bardzell, S. (2018b). Utopias of participation: Feminism, design, and the futures. *ACM Transactions on Computer-Human Interaction*, 25(1), 1–24. <https://doi.org/10.1145/3127359>
- Baumann, K., Stokes, B., Bar, F., & Caldwell, B. (2017). Infrastructures of the imagination: Community design for speculative urban technologies. *ACM International Conference Proceeding Series, Part F1285*, 266–269. <https://doi.org/10.1145/3083671.3083700>
- Blythe, M. A., & Wright, P. C. (2006). Pastiche scenarios: Fiction as a resource for user centred design. *Interacting with Computers*, 18(5), 1139–1164.
- Braun, V., & Clarke, V. (2020). One size fits all? What counts as quality practice in (reflexive) thematic analysis? *Qualitative Research in Psychology*, 1–25.
- C Smith, R., Bossen, C., Dindler, C., & Sejer Iversen, O. (2020). When Participatory Design Becomes Policy: Technology Comprehension in Danish Education. *Proceedings of the 16th Participatory Design Conference 2020-Participation (s) Otherwise-Volume 1*, 148–158.
- Candy, S. (2019). Turning Foresight Inside Out : An Introduction to Ethnographic Experiential Futures. *Journal of Futures Studies*, 23(March). <https://doi.org/10.6531/JFS.201903>
- Clarke, V., & Braun, V. (2014). Thematic analysis. In *Encyclopedia of critical psychology* (pp. 1947–1952). Springer.
- Coskun, A., Metta, J., Bakırlioğlu, Y., Çay, D., & Bachus, K. (2022). Make it a circular city: Experiences and challenges from European cities striving for sustainability through promoting circular making. *Resources, Conservation and Recycling*, 185, 106495. <https://doi.org/https://doi.org/10.1016/j.resconrec.2022.106495>
- Devan Shah, A., Gonçalves, M., & Mulder, I. (2020). Design research for participatory policies: Paradoxes, Themes, Futures. *Proceedings of the 16th Participatory Design Conference 2020-Participation (s) Otherwise-Volume 2*, 82–86.
- Dunne, A., & Raby, F. (2013). *Speculative everything: design, fiction, and social dreaming*. MIT press.
- Einarsson, Á. M., & Hertzum, M. (2021). Me-to-We Design: How Can a Makerspace Nurture the Building of a Collaborative Community? *Human-Computer Interaction–INTERACT 2021: 18th IFIP TC 13 International Conference, Bari, Italy, August 30–September 3, 2021, Proceedings, Part I 18*, 702–711.
- Gidley, J. M., Fien, J., Smith, J. A., Thomsen, D. C., & Smith, T. F. (2009). Participatory futures methods: Towards adaptability and resilience in climate-vulnerable communities. *Environmental Policy and Governance*, 19(6), 427–440. <https://doi.org/10.1002/eet.524>
- Hancock, T., & Bezold, C. (1994). Possible futures, preferable futures. *The Healthcare Forum Journal*, 37(2), 23–29.
- Hobson, K. (2016). Closing the loop or squaring the circle? Locating generative spaces for the circular economy. *Progress in Human Geography*, 40(1), 88–104.
- Kohtala, C. (2015). Addressing sustainability in research on distributed production: an integrated literature review. *Journal of Cleaner Production*, 106, 654–668.
- Kohtala, C., & Bosqué, C. (2014). *The story of MIT-Fablab Norway: community embedding of peer production*.
- Kuznetsov, S., & Paulos, E. (2010). Rise of the expert amateur: DIY projects, communities, and cultures. *Proceedings of the 6th Nordic Conference on Human-Computer Interaction: Extending Boundaries*, 295–304.
- Lindtner, S., Hertz, G., & Dourish, P. (2014). *Emerging Sites of HCI Innovation : Hackerspaces , Hardware Startups & Incubators*. 439–448.
- MacArthur, E. (2013). Towards the circular economy. *Journal of Industrial Ecology*, 2(1), 23–44.
- Martinez, S. L., & Stager, G. (2013). Invent to learn. *Making, Tinkering, and Engineering in the Classroom. Torrance, Canada: Construting Modern Knowledge*.
- Merli, R., Preziosi, M., & Acampora, A. (2018). How do scholars approach the circular economy? A systematic literature review. *Journal of Cleaner Production*, 178, 703–722.

- Muller, M., Bardzell, J., Cheon, E., Su, N. M., Baumer, E. P. S., Fiesler, C., Light, A., & Blythe, M. (2020). Understanding the past, present, and future of design fictions. *Conference on Human Factors in Computing Systems - Proceedings*, 1–8. <https://doi.org/10.1145/3334480.3375168>
- Oliver, K. M. (2016). Professional development considerations for makerspace leaders, part two: Addressing “how?” *TechTrends*, 60, 211–217.
- Ollenburg, S. (2019). A Futures-Design-Process Model for Participatory Futures. *Journal of Futures Studies*, 23(June 2019), 51–62. <https://doi.org/10.6531/JFS.201906>
- Oostveen, A.-M., & den Besselaar, P. (2004). From small scale to large scale user participation: a case study of participatory design in e-government systems. *Proceedings of the Eighth Conference on Participatory Design: Artful Integration: Interweaving Media, Materials and Practices-Volume 1*, 173–182.
- Peppler, K., Halverson, E., & Kafai, Y. B. (2016). *Makeology: Makerspaces as learning environments (Volume 1)* (Vol. 1). Routledge.
- Prendeville, S., Hartung, G., Brass, C., Purvis, E., & Hall, A. (2017). Circular Makerspaces: the founder’s view. *International Journal of Sustainable Engineering*, 10(4–5), 272–288.
- Ramirez Galleguillos, M. L., Eloiriachi, A., Serdar, B., & Coşkun, A. (2022). Imagining Emerging Technologies for Promoting Intercultural Meaningful Social Interactions: A Participatory Futures Approach. *ACM International Conference Proceeding Series*, 102–116. <https://doi.org/10.1145/3569219.3569269>
- Roldan, W., Hui, J., & Gerber, E. M. (2018). University makerspaces: Opportunities to support equitable participation for women in engineering. *Int. J. Eng. Educ*, 34(2), 751–768.
- Saad-Sulonen, J., Eriksson, E., Halskov, K., Karasti, H., & Vines, J. (2018). Unfolding participation over time: temporal lenses in participatory design. *CoDesign*, 14(1), 4–16.
- Shklovski, I., & Grönvall, E. (2020). CreepyLeaks: Participatory Speculation Through Demos. *ACM International Conference Proceeding Series*. <https://doi.org/10.1145/3419249.3420168>
- Spekkink, W., Rödl, M., & Charter, M. (2022). Repair Cafés and Precious Plastic as translocal networks for the circular economy. *Journal of Cleaner Production*, 380, 135125.
- Taylor, N., Hurley, U., & Connolly, P. (2016). Making community: the wider role of makerspaces in public life. *Proceedings of the 2016 CHI Conference on Human Factors in Computing Systems*, 1415–1425.
- Törnroth, S., Day, J., Fürst, M. F., & Mander, S. (2022). Participatory utopian sketching: A methodological framework for collaborative citizen (re)imagination of urban spatial futures. *Futures*, 139(July 2020). <https://doi.org/10.1016/j.futures.2022.102938>

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