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Participation, Co-Planning, and Reflection: A Case Study of the Jonction Living Lab in Geneva on Urban Heat Island Adaptation

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Abstract

The Jonction Living Lab in Geneva provides a valuable case for examining how participatory processes in urban climate adaptation unfold, focusing on participation, co-planning, and reflection. Driven by co-creation, the project seeks to address adaptation to the urban heat island (UHI) phenomenon while promoting well-being and empowering residents of a neighbourhood in Geneva, la Jonction. This thesis examines participation across three dimensions: first, it examines the extent and dynamics of stakeholder involvement in two planning workshops; second, it investigates how co-planning processes, including exchanges with the City of Geneva, shaped the evolution from initial participatory proposals to concrete intervention plans; and third, it assesses how interventions were reflected upon during an implementation phase through a workshop and follow-up meetings with the core team, based on the application of the Theory of Change framework (Forbat et al., 2025). By connecting these dimensions, the study underscores the potential and limits of participatory methods for inclusive UHI adaptation. It argues that living labs function not only as experimental arenas for reimagining public space, but also as platforms for negotiating collective responsibility and building more resilient urban futures – although the process is not without its hitches and faults. Understanding these dynamics is crucial for fostering governance processes that promote social equity, climate justice, and durable pathways of urban resilience.

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1. Introduction

With the acceleration of global urbanization, more than 50% of world's population now live in urban areas, a figure expected to reach 70% by 2050 (UN-Population Division, 2018). Urban areas are becoming hotspots of environmental degradation. Although they occupy a tiny part of the planet's surface (less than 1%), they are responsible for a disproportionately large share of environmental pressures. 40-70 % of greenhouse gas emissions are generated by urban areas (UN-Habitat, 2011). Much of this footprint is linked to fossil fuel dependence, whether for electricity, transport, heating and cooling buildings, industrial activity, or waste management. One of the less visible but increasingly important consequences of this urban footprint is the urban heat island (UHI) effect, a phenomenon whereby urban areas are significantly warmer than their surrounding rural areas, due to the built environment, but also heat released by cars and air-conditioning. Research suggests that, by 2050, the extra warming caused by UHI could amount to roughly half of the warming attributed to climate change over the same period (Harvey, 2019). This means that cities are not only bearing the impacts of climate change but also exacerbating them. High-density building developments, impervious surfaces such as asphalt roads, all reduce natural cooling and trap heat. In addition, urban traffic, waste heat from air conditioning, and other energy-intensive activities further increase temperatures, contributing to intensified thermal discomfort. This is particularly evident during extreme heatwaves driven by climate change, disproportionately impacting vulnerable groups. Faced with these challenges, questions about how to design urban environments and how to change social practices that help people adapt, while also improving their everyday comfort, are no longer theoretical. They have become urgent matters for public health, social equity, and climate resilience. This study focuses precisely on that intersection: how actions can be taken in public, outdoor space to improve thermal comfort and community well-being in the face of urban heat in cities.

At the same time, urban areas have also exhibited tremendous opportunities for sustainable transformation in recent years. Urban Living Labs (ULLs) are increasingly recognized as a vital path for exploring urban governance and sustainable transformation (Steen & Van Bueren, 2017). As a user-centered and real-world innovation approach, it has been widely used in urban planning, sustainable development, and policy innovation through collaboration with multiple stakeholders. This study is based on the pilot project "Jonction Living Lab" within the Swiss national research program SWICE (Sustainable Well-being for Inclusive Energy Transition), financed by the Federal Office of Energy. Located in a densely populated, socially diverse Geneva neighbourhood, increasingly impacted by summer heatwaves, the Jonction Living Lab aims to reduce thermal discomfort, promote sustainability, and enhance well-being. To understand what actions should be promoted to foster both climate adaptation and residents' well-being, Jonction Living Lab aimed at a collaboration through a multi-stakeholder approach. Its planning phase, conducted between 2024 and early 2025, included participatory workshops and meetings with the city administration, among other actors. These participatory processes created opportunities for knowledge exchange, the development of initial participatory proposals, and iterative refinement toward feasible interventions. The implementation phase started in June 2025 and involved providing people with equipment for personal cooling, exploring la Jonction through a hot and cool map, but also proposing activities around keeping cool, and accompanying the design of street-level interventions for cooling spaces. In parallel, the governance of the Living lab was ongoing through regularly scheduled meetings with the core team and other actors. Implementation is ongoing at the time of writing, with activities ending the first week of September.

Rather than evaluating technical outcomes, this research centers on the participation dynamics and design processes that shaped the project. It investigates how different actors engaged with the Jonction Living Lab over time, how participatory methods were structured, and how initial proposals evolved into concrete intervention plans. Accordingly, the study is guided by the following research question:

How did participation dynamics and designs evolve during the planning and implementation phases of the Jonction Living Lab, focusing on urban heat island adaptation, from the core team to multiple stakeholders?

To explore this question in depth, the following sub-questions are proposed:
1. What were the degrees of participation and the interaction dynamics among multiple stakeholders in the planning phase?
2. How did the co-planning process shape the evolution from initial participatory proposals to the planned interventions?
3. How can a theory of change be used to assess and reflect on planned interventions during the implementation?

Through these questions, the study examines the interactions and decision-making processes among diverse participants in the Living Lab. It explores how different knowledge systems (scientific, experiential, and professional) were integrated during co-design, co-planning and implementation process. The goal is to offer insights into how Living Labs can more effectively structure participatory design processes to address complex urban challenges such as urban heat adaptation.

By focusing on the processual dimensions of co-design and participation, this research contributes to the evolving literature on transdisciplinary urban experimentation. It aims to provide practical and analytical insights that support the design of more adaptive, reflective, and responsive Living Lab processes in the future.

2. Literature Review

In response to the research question, many relevant theoretical perspectives are reviewed. They are briefly summarized as follows: (1) living labs and participatory urban heat adaptation, (2) participatory dynamics and co-creation in urban governance, and (3) theories of change and reflective implementation.

2.1 Living Lab and Participatory Urban Heat Adaptation

2.1.1 Origins and Evolution of Living Lab Concept

According to Niitamo et al. (2006), the living lab concept was first introduced by Professor William J. Mitchell of the Massachusetts Institute of Technology. While the "home lab" focused on testing technologies and other products in home-like settings, the living lab extends beyond the home to address complex issues through collaborative co-creation, user-led processes, and real-life context embedding. Ballon & Schuurman (2015) described the early innovative concepts of "participatory design", "social experiment" and "digital city" as the three predecessors of living labs. From 2003 to 2005, the European Union promoted and institutionalized the Living Lab concept through various policy-level endorsement and funding mechanisms, facilitating both local implementation and cross-regional collaboration across Europe. This not only enriched the practical scenarios for Living Labs but also laid the foundation for the formation of the European Living Lab Network (or ENOLL), founded in 2006. In addition, the World Bank has begun to promote living labs globally as an innovation policy tool for developing countries (Garcia et al., 2010; Eskelinen, et al., 2015). The membership of ENoLL has also expanded from the original European initiative to include countries such as Brazil, Colombia, Canada, Mexico, Australia, China and Egypt, marking the global expansion of the European living lab model.

In recent years, it has become a top priority to seek new ways to address major challenges such as climate change, resource depletion and population aging. Politicians and academics seek innovative cooperation models, and higher education institutions (HEIs) are expected to participate. Researchers argue for the need to change research practices towards fostering cross-border cooperation with multiple stakeholders and the integration of multiple needs and disciplinary expertise to promote sustainable development (Tercanli & Jongbloed, 2022). In this context, living labs have flourished as sustainable innovation platforms. Many living labs have emerged around the world, focusing on the United Nations' Sustainable Development Goals (SDGs) and committed to solving global challenges. Zingraff-Hamed et al. (2019) note that Living Labs are widely used to tackle the complex “wicked” problem of climate change, because they allow stakeholders to jointly design and test policy solutions. For example, they can support polycentric governance by fostering collaboration between different levels of government and organizations that usually operate in silos (Zingraff-Hamed et al., 2019). At the same time, Living Labs emphasize local engagement: citizens, researchers, public authorities, and private actors work together, making governance processes more participatory and responsive to local needs.

The SWICE project (Sustainable Wellbeing for the Individual and the Collectivity in the Energy Transition) was launched in 2022, funded by the Swiss Federal Office of Energy and with a focus on living lab approaches to support the energy transition. The project will run until 2029 and is committed to balancing the social, economic and environmental aspects of energy transformation, seeking to coordinate the needs of individuals and communities with

the needs of sustainable development. There are currently 7 living labs in Geneva, Fribourg, Zug, Aarau and other regions. Each living lab is developing around specific themes, such as mobility, indoor architecture, and adaptation strategies for urban heat island effects

2.1.2 Definition and Elements of Living Lab

As with the changing evolution of living labs, a large number of different definitions have been proposed in the literature to explain what living labs are. However, there is still no unified definition of Living Lab, and its meaning varies significantly in different contexts and application backgrounds (Voytenko et al., 2016). Eriksson et al. (2005) defined living labs as a user-centered research method. It can be used to sense, prototype, verify and improve complex solutions in multiple and evolving real-life situations. Later, Niitamo et al. (2006) discussed living labs as a multi-context R&D method. Ballon et al. (2005) described living labs from another perspective as experimental environments for shaping technology in real-life scenarios, where end users are given the key role of "co-producers" rather than passive recipients. Almirall & Wareham (2008) agree with this view, saying that living labs are driven by two main ideas: i) involving users as co-creators on an equal basis with other participants, and ii) conducting experiments in real-world environments. While Bergvall-Kåreborn et al. (2009) refer to Living Labs as a multidisciplinary phenomenon, Laborgne et al. (2021) argue that a transdisciplinary nature is a core characteristic. Specifically, they bring together scientists and non-scientists to jointly frame problems, develop solutions, and learn from real-world experimentation. Covering disciplines ranging from innovation management to information science (Leminen & Westerlund, 2019), Living Labs can also be associated with the open and user innovation paradigm. This paradigm emphasizes that innovation does not emerge only within firms or research institutions, but is increasingly co-created with external actors, especially end-users. Open innovation (Chesbrough, 2003) highlights the use of external knowledge and collaboration across organizational boundaries, while user innovation (von Hippel, 2005) stresses the active role of users in generating and testing new ideas, emphasizing users as co-creators, and encouraging collaborative innovation across stakeholders. According to Leminin and Wsterlund (2019), a living lab supports stakeholders in addressing environmental, economic and social issues through collaboration and open innovation. Similarly, Edwards-Schachter, Matti, & Alcántara (2012) defined living lab as an organizational approach that emphasizes user participation in innovation and the use of innovation. Its core concept is to promote the development and optimization of technology, services and policies through experiments and collaboration in real environments.

Almirall & Wareham (2008) mentioned the core driving factors of Living Lab is to involve users in the early stages of the innovation process and experiment in real-world environments. The inherent experimental setting of LLs implies user involvement (Voytenko et al., 2016), contributing to the design, development, and testing of innovations aimed at addressing sustainability challenges (Nyström et al., 2014; Bulkeley et al., 2013). Thus, participation and co-creation are foundational principles of Living Labs, distinguishing them from conventional top-down innovation or policy processes. Ballon & Schuurman (2015) believed that the framework of Living Lab particularly emphasizes five core elements: active user participation; real life environment; multi- stakeholder participation; multi-method integration; and co-creation. Therefore, Living Labs can serve as experimental platforms for jointly developing, testing and improving sustainable adaptation strategies, and promote cooperation among different stakeholders (including policymakers, researchers, businesses and residents). According to their framework, user participation plays a key role in shaping policy processes and design, aiming to achieve coordinated optimization across social,

environmental, and institutional dimensions. Hossain, Leminen & Westerlund (2019) argue that Living Labs involve a wide range of stakeholders (such as government, business, academia, communities, and citizens) and promote innovation through collaboration. They leverage user participation, co-creation, and iterative development to ensure that the innovation process reflects users' actual needs and preferences. Importantly, they emphasize experimentation and testing in real-world environments, which exposes innovations to the social, technical, and environmental conditions in which they will ultimately be applied. This allows potential barriers, opportunities, and unintended effects to be identified early, thereby increasing the likelihood that proposed solutions will be both practical and scalable.

In summary, as real-world participatory innovation platforms, living labs emphasize collaboration, co-creation, user experimentation, and iterative improvement to ensure that the innovation process reflects the actual needs and preferences of multiple stakeholders.

2.1.3 Urban Heat Adaptation within Living Lab Framework

The urban heat island (UHI) effect has become one of the most serious environmental and public health challenges in densely populated areas. Traditional technology-focused responses often overlook the complexities of the social dimension and fail to address the multidimensional impacts of UHI. Urban residents not only experience physical discomfort from heat exposure but may also experience psychological stress caused by heat disturbance (Fahy et al., 2025). The longer the duration of heat discomfort, the more severe the health impacts, ranging from mild discomfort to the risk of heat-related mortality, depending on the intensity and duration of the heat and individual physiological sensitivity (Armstrong et al., 2019; Ragettli et al., 2017). The UHI effect not only burdens public health systems but also significantly increases energy consumption for cooling. Furthermore, the impact of UHI is uneven across social groups. Low-income groups often lack access to green space, shade, or accessible public cooling spaces, and therefore face higher risks of heat exposure (Sung, 2013). In this context, social equity should be central to the development of heat island adaptation strategies. Ensuring that all residents enjoy thermal comfort during high temperatures, rather than just the privileged few with private air conditioning or green courtyards, is a key path to achieving climate justice. Therefore, promoting low-tech public cooling facilities offers a more sustainable alternative to private, energy-intensive cooling systems, as such public spaces, indoors and outdoors, can provide more collective solutions.

Research has demonstrated that shade plays a significant role in improving thermal comfort (Fahy et al., 2025). They found that shaded areas exhibit significantly lower Physiological Equivalent Temperatures (PETs) and emphasis any form of shade is a key factor in reducing thermal discomfort. However, biological shade provides greater shading than artificial shade, primarily due to evapotranspiration from trees (Shashua-Bar et al., 2011). In contrast, low-lying shrubs or ground cover plants provide less cooling (Fahy et al., 2025). Beyond shade, other microclimatic factors significantly influence thermal comfort, including access to water features, as well as wind and air circulation (Kleerekoper, et al., 2012). Therefore, urban heat island adaptation strategies should integrate shading, water features, and ventilation elements. Creating accessible cool areas in public spaces that combine multiple cooling factors and beneficial for all citizens.

Solutions to the urban heat island (UHI) effect still tend to be focused primarily on engineering dimensions, such as building materials, greening forms, and energy technologies, while governance-related factors, such as social equity, policy implementation, and public

participation, receive comparatively less attention (Estrada et al., 2017). Rizwan et al. (2008) noted that technology-centric approaches alone cannot guarantee effective and equitable urban heat adaptation. Despite the development of technological approaches, their effectiveness depends heavily on evolving social values and public willingness to cooperate. Wang et al. (2021) further emphasized that public awareness, attitudes, and daily behaviors play a decisive role in the acceptance and implementation of UHI strategies. Without an understanding of prevailing social perceptions, adaptation measures may face resistance and even fail to address the real needs of the most vulnerable. In this context, living labs provide a path for achieving social inclusion and participatory governance in urban heat adaptation. They are increasingly becoming a key framework integrating research, innovation, and public engagement, and are widely applied to issues such as energy transition, social inclusion, and environmental justice (Voytenko et al., 2016). Its open framework enables diverse stakeholders, including urban residents, researchers, planners, and community organizations, to collaboratively explore UHI adaptation strategies based on equity and sustainability. By embedding and testing interventions in real urban environments, the Living Lab can validate potential pathways to addressing urban heat challenges and provide governance insights for a more inclusive urban future.

2.2 Participatory Dynamics and Co-Creation in Living Labs

The following sections will delve deeper into how participatory dynamics and co-creation mechanisms operate within LLs, examining their role in fostering sustainable urban transformations and the challenges that arise in reconciling diverse stakeholder interests.

2.2.1 Participation and Its Dynamics

Distinguishing them from conventional top-down urban planning models, Living Labs emphasize iterative engagement among diverse stakeholders throughout the design, testing, and implementation phases. Participation is therefore the basis. Eriksson et al. (2005)'s research shows that citizens and civil society are important sources of innovation in living lab. The efficiency of living labs is based on the creativity and active participation of users (Mulder et al., 2008). Bergvall-Kareborn et al. (2009) further pointed out that the diversity of social users constitutes an important resource of living labs. They are not only recipients of innovation, but also co-creators of innovation, directly participating in the design, testing and evaluation process. Therefore, the diversity and dynamics of stakeholder participation are vital to the success of Living Labs. Different stakeholders play vital roles in the innovation process of living labs. They should all be regarded as partners, and their needs and opinions should be fully considered. However, participatory dynamics within Living Labs are far from uniform; they are shaped by varying stakeholder roles, power relations, motivation levels, and institutional constraints. Understanding how these dynamics unfold, and how they impact the quality and outcomes of collaboration, has become an essential area of inquiry in Living Lab research and practice.

Diversity of participants

Compared with traditional urban governance solutions, the distinctive feature of Living Labs is the heterogeneity of their participants. Ståhlbröst (2008) highlights that innovation in Living Labs is guided by cooperation among multiple stakeholders. Building on this, Ballon & Schuurman (2015) emphasize that participants may include both individual actors (e.g., scholars, developers, business representatives, and citizens) and collective entities (e.g., public and private organizations). This diversity creates opportunities for cross-sectoral and

cross-border collaboration, which enhances the exchange of complementary knowledge and perspectives. When these varied inputs are integrated through co-creation, Living Labs provide a platform for enables end users to carry out innovative practices together with enterprises, the public sector and research institutions to generate innovations that are more responsive to citizen needs and local contexts (Almirall & Wareham, 2008).

Evans et al. (2015)'s empirical study of university campuses as living labs further revealed that participants can include diverse subjects such as researchers, student groups, non-governmental organizations, small and medium-sized enterprises, and environmental consultants. Ideally, these participants become a community of interest working in cooperation and focusing on effectively solving specific problems. Through knowledge co-creation, all parties promote the development of sustainable products and services in real scenarios. Hyysalo & Hakkarainen (2014) further emphasize from the perspective of user innovation and participatory design, that end-users are no longer passive recipients, but rather important co-producers. At the same time, it is worth noting that the innovation process requires both users who play active roles and users who play passive roles (Leminen et al., 2015). Active roles refer to users who actively co-create and influence the innovation process. They actively shape the development process by contributing ideas, expertise, or practical insights. While passive roles involve users who contribute indirectly through usage or observation for validating innovations without requiring their direct input in the design phase. Both are deemed necessary to balance creativity with practical implementation, particularly in the resource-constrained Living Labs. However, according to O'Faircheallaigh, (2010), the socially powerless are actually the least likely to participate, both because they lack the resources to do so and often find the processes involved to be unfamiliar and daunting.

As society increasingly focuses on the democratic nature of innovation, Carayannis & Campbell (2009) proposed a quadruple helix model, i.e. an innovation community formed by industry, academia, government departments and civil society. This model describes the interaction between four key actors in the innovation process. Academia might contribute research and expertise. Industry might provide resources and technological solutions. Government might offer policy support and funding. Civil society would be active participants in the design, testing, and evaluation phases. Compared to traditional triple helix, the introduction of civil society as the fourth helix dimension provides a critical extension to innovation, highlighting the active role of users, citizens and cultural values in the innovation process. The model embodies the ideas of “co-creation” and “social and technological co-evolution”, which is particularly applicable to the analytical frameworks of living labs, smart cities and social and technological transformations, bringing the innovation process closer to social needs and enhancing the acceptability and usability of solutions, and usability of solutions. Therefore, the quadruple helix model provides a useful lens to visualize and analyze complex relationships with various stakeholders and their collaborations within a Living Lab. It helps to examine the collaborative ecosystem of a Living Lab and to understand how the interactions between these four groups contribute to the overall success and impact of the Living Lab initiatives.

Participation dynamics

Reed (2008) defined participation “as a process where individuals, groups and organizations choose to take an active role in making decisions that affect them” (p. 2418). Participation dynamics refers to the interaction patterns and behavioral characteristics of multiple stakeholders in the participation process. The participation dynamics within Living Labs

focus on the diverse roles of users and the varying levels of engagement. Research has shown that participation dynamics are influenced by participant role, attributes and size (Nyström et al., 2014; Leminen et al., 2014; Menny et al., 2018). Specifically, Nyström et al. (2014) classify different users as various roles, such as information provider, testers, contributors, and co-creators. They noted that multiple roles often coexist, with "contributor" being the most prevalent. Leminen et al. (2014) further pointed out that the role played by users in living labs is influenced by their individual attributes, including their capabilities, motivation, experience level, social capital, background knowledge, etc. Besides, Menny et al. (2018) emphasize that optimizing the size of participants is crucial for improving co-creation efficiency. An overly large group can lead to decreased collaboration efficiency.

In practice, the dynamics of participation in Living Labs often require a balance between top-down coordination and bottom-up initiative. Leminen et al. (2012) noted that top-down, hierarchical innovation is suitable for technology-driven Living Labs, while bottom-up approaches emphasize the initiative of local stakeholders. Juujärvi & Lund (2016) advocate for a combined bottom-up and top-down approach to ULLs. This approach allows for the identification of needs and ideas (bottom-up) while simultaneously validating those needs and providing formal structure (top-down). Furthermore, Leminen (2013) categorizes LL participation into inhalation and exhalation approaches. The inhalation approach, user-led, prioritizes listening to user needs, absorbing their experiences, and co-designing solutions. This emphasizes user initiative and ownership, particularly suitable for projects focused on social participation and equity. Conversely, the exhalation approach, led by institutions, focuses on "exporting" solutions to the public for testing and feedback, often used in technology-focused projects. In practice, these approaches often complement each other. In terms of participation mode, living labs can be divided into open and closed types (Dell'Era & Landoni, 2014). Open living labs adhere to the logic of "bottom-up" governance, allowing the public to participate freely to obtain diversified user feedback. Its basis is to guarantee the democratic rights of the public and let them participate in the planning and decision-making process from the beginning. The closed type pre-screens participants. Relatively speaking, closed participation can keep the research highly targeted, but it requires precise selection of target users to ensure the effectiveness of problem solving. The specific form of user participation varies depending on the type of living lab (Leminen et al., 2012), including feedback provision, answering questions, voting, and contributing to development processes and decision-making (Friedrich et al., 2013). But the most basic way of participation includes providing various contents, design solutions and multimedia materials (Følstad, 2008). This participation mechanism enables the Living Lab to integrate users' diverse knowledge, creativity and experience, thereby promoting the development of new products and services (Hielkema & Hongisto, 2013).

Schuurman & De Marez (2015) categorize user innovation as design for, with, and by users, with "design with" being most common. Early and active user involvement is crucial for shaping the ULL process rather than merely reacting to it (Bergvall-Kåreborn & Ståhlbröst, 2009). This ensures the identification of user needs and the establishment of a shared vision (Baccarne et al., 2014; Salter & White, 2013). Users bring valuable experience-based knowledge, needs, and preferences, empowering them and fostering a sense of co-ownership, thereby strengthening trust and commitment to LL goals (Friedrich et al., 2013; Juujärvi & Lund, 2016). While user involvement is vital for LL success, it shouldn't be considered an end in itself. Rather, it should be understood as a means to foster meaningful collaboration, co-learning, and context-sensitive innovation. Simply engaging users without ensuring that their inputs influence decisions can lead to tokenism or superficial participation

(Kowaltowski, 2024). True participatory value emerges when users are not only included in the process but also empowered to shape outcomes, challenge assumptions, and co-produce knowledge alongside other stakeholders.

The dynamics of stakeholder participation in urban planning have been widely theorized, particularly in relation to communicative planning and collaborative governance (Healey, 1997). However, participation is not a neutral act. Healey (1997) and Chambers (2002) emphasize that participatory dynamics shaped by asymmetries in knowledge, power, discourse, and institutional norms. Although Living Labs emphasize user participation, research has found that citizen voices are often marginalized due to power imbalances (Nguyen et al, 2022). To navigate these tensions, Vachon et al. (2013) point to enable informal exchanges and flexibility in process design to accommodate diverse knowledge systems and expectations. What's more, the participation is fluid. Inclusion and exclusion could shift over time and require adaptive facilitation (Chambers, 2002; Vachon et al., 2013). However, long-term participation can lead to a decline in stakeholder enthusiasm, which is participation fatigue. As noted by Du Toit & Pollard (2018), "participation fatigue" may set in when stakeholders are engaged repeatedly participate in public events (e.g., workshops, conferences) without visible outcomes or their inputs reused. Similarly, the framing of citizens as passive recipients rather than active agents can limit their commitment to the process. Thus, addressing these issues requires deliberate strategies. We must ensure co-creation is both inclusive and consequential, focusing on real impact rather than just the process.

Level of participation

Arnstein's "Ladder of Citizen Participation" (1969) is a classic framework for analyzing the degree of power-sharing in participatory processes. It categorizes participation into 8 rungs, grouped into 3 levels: (1) no participation (2) tokenism (3) citizen power. It describes the degree of public participation in decision-making, ranging from complete powerlessness to full control. The "non-participation" level includes "manipulation" and "therapy". These approaches are not truly participatory. "Manipulation" involves citizens being included only symbolically in the process, with the goal of persuading them to accept the decision, such as nominal public hearings. "Therapy", on the other hand, treats residents' objections as "emotional issues" and uses comfort workshops to correct their attitudes rather than address their concerns. The "tokenism" level includes "informing", "consulting", and "placing". At this stage, citizens can obtain information and even express their opinions, but the actual decision-making power remains in the hands of officials. For example, press conferences, surveys, or advisory committees provide channels for citizens to express their opinions, but there is no guarantee that these opinions will influence the decision. The "Citizen Power" level represents true participatory power. "Partnership" means citizens and authorities share decision-making equally, such as through co-managed projects. "Delegated Power" means citizens have control over specific matters, such as community councils with veto power. Finally, "citizen control", at the top level, represents communities independently

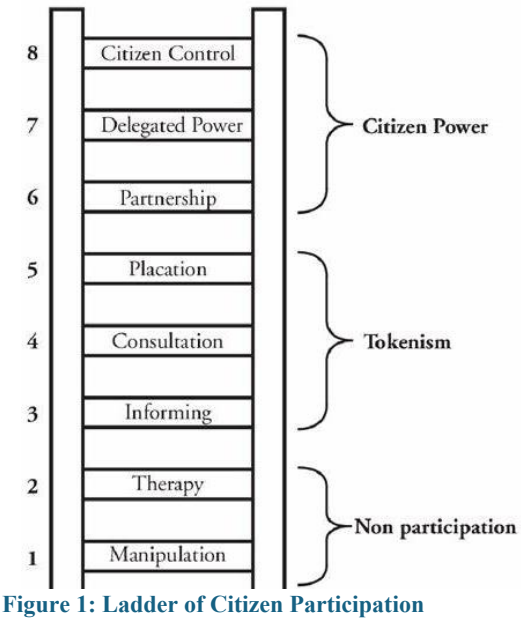


Figure 1: Ladder of Citizen Participation (Arnstein,1969)

formulating and implementing policies without external interference, as in self-managed cooperatives or community-led urban planning. This model emphasizes that participation is meaningful only when citizens truly have the power to influence decision-making.

However, many studies have pointed out that different situations may require different levels of participation, and it is not always necessary to pursue the highest level of participation. Fung (2006) points out that while public empowerment is a worthy goal in some situations, consultation level of participation may be more suitable than citizen control in others. Tippett et al., (2007) explain that the appropriate level of stakeholder participation depends on the project goals and the ability of stakeholders to influence the outcomes. Krütli et al. (2010) add that the best participation methods depend on several factors: the participation's purpose, the number and expertise of participants, and the topic itself. The levels of participation are also related to the diversity within and between stakeholder groups (Luyet et al. 2012). Therefore, Menny et al., (2018) suggest that the key to participation is to employ diverse methods, incorporating various stakeholders and combining different levels of participation, according to the specific LL's goals, vision, and other influencing factors. This is more likely to improve outcomes and transformative potential than simply pursuing the highest level of participation. Furthermore, the principle that more participation is always better doesn't always hold true (Menny et al., 2018). The number of participants should be determined by the importance and scope of the issue at hand. Broader issues need smaller groups, while more targeted questions require larger groups to participate (Friedrich et al., 2013). It's important to consider the right format and the right timing. Depending on the context, engaging stakeholders may require a tailored combination of different methods to serve distinct purposes at various stages, while in other cases, applying a consistent technique over time may be more effective for ensuring comparability and continuity (Krütli et al., 2010). Furthermore, levels of participation are not clear-cut and static. Stauffacher et al. (2008) highlight the blurred boundaries between participation levels. They identify "participation hybrids" integrating multiple levels. That means some participation formats that integrate more than one level of participation. Moreover, rather than remaining static, participation deepened over time (Stauffacher et al., 2008). Participants initially listened and received information, but as trust developed, they gradually shifted towards more active contributions and joint decision-making.

2.2.2 Participation in Creation and Planning

The participatory creation and planning phase is crucial to the long-term success of a Living Lab, as it lays the foundation for collaboration, trust-building, and shared ownership among stakeholders. A first and essential step in this phase is problem-framing, that is, jointly developing a shared understanding of the challenges at hand before moving on to define goals and priorities. This framing process helps align diverse perspectives and ensures that subsequent discussions are grounded in a common problem definition. Once this shared framing is established, stakeholders can then define goals and priorities, while also establishing processes that enable them to contribute their expertise, local knowledge, and lived experiences. Furthermore, climate adaptation strategies require not only social and technical buy-in but also institutional support. Thus, effective co-creation and co-planning must integrate top-down institutional frameworks with bottom-up, community-led initiatives to ensure that proposed interventions are both feasible and closely aligned with local needs.

Co-creation

Christiaanse (2025) defines co-creation as an approach whereby officials and local communities work together to create practical outcomes through deliberation at all stages of the planning process. Co-creation is therefore not merely about consultation, but involves the shared of knowledge, production of solutions, and interventions in real-world settings. The essence of co-creation lies in collaboration throughout the entire process. Living Lab advocates co-initiation from the problem definition stage. First, scientists and real-world participants from related disciplines must join to establish a collaborative research team from the beginning, because they have relevant experience, expertise or practical interests in the pre-defined problem areas (Pohl & Hadorn, 2007). The inclusion and exclusion of research projects are determined through a set of transparent and well-reasoned criteria. Then, at the beginning of the research, team members should jointly define terms that are critical in the problem area or have different interpretations in interdisciplinary collaboration and establish a shared understanding not only of the research process but also of the problem itself (Stokols et al., 2010). Afterwards, the team can absorb more experts or practical participants in related fields as needed to continuously improve the research. This is an iterative process. Unlike traditional technical experiments or consulting research, cross-science co-creation requires researchers to abandon the "expert-led" role and become guides, learners and collaborators. Furthermore, Living Lab leader also plays a key role in initiating and facilitating the value co-creation process (Chronéer et al., 2019; Juujärvi & Lund, 2016), acting as facilitators or catalysts to drive collaborative innovation (Ansell & Gash, 2012). In this process, the understanding and trust jointly built become the social capital to promote innovation and lay the foundation for the implementation of solutions (Rădulescu et al., 2023). However, although this is a co-creation process with communication and coordination, the ultimate goals of different stakeholders may not be the same. Research should identify and clearly articulate the differing interests of scientists and practitioners involved in a project (Wiek, 2007) and ensure the smooth conduct of the research by publicizing these differences.

Furthermore, co-creation not only means the participation of stakeholders in the process but also manifests itself in the knowledge production models. Team members should not be restricted to individuals with expertise in a single discipline but also combine concepts and methods from multiple different fields. They should work collaboratively over an extended period to develop innovative, transdisciplinary frameworks that surpass the limitations of any one perspective. This approach is essential for addressing complex, real-world problems effectively (Stokols et al., 2010). Compared with multidisciplinary, in which researchers from different fields work independently, communicate regularly, and jointly analyze problems; and interdisciplinarity, which emphasizes the integration of methods and perspectives from different fields. Transdisciplinary emphasizes the integration between scientific knowledge and practice-based knowledge. Through equal cooperation between scientists and non-scientific actors (such as citizens, businesses, and policymakers), problems are jointly identified, goals are defined, and solutions are designed (Lang et al., 2012). When dealing with complex issues such as the urban heat island effect, relying solely on knowledge from a single discipline is often not enough to provide feasible solutions. The integration mechanism of trans-disciplinarity is to incorporate knowledge from fields such as climate science, architecture and urban design, sociology, ecology, and policy research into the innovation process together with local knowledge, life experience, and cultural norms, thereby enhancing the adaptability and feasibility of the solution. As an institutionalized participation platform, Living Lab can provide space for continuous dialogue, experimentation and adaptation for transdisciplinary, making the co-creation process more sustainable. Besides, given the diversity of LL application contexts, there are different understandings of what

constitutes co-creation and the need to find appropriate methods to study its dynamics in practice. Puerari et al. (2018) proposed five elements of co-creation: (1) the purpose of co-creation; (2) formal and informal co-creation; (3) ownership of the co-creation process; (4) motivation and incentives of participants; and (5) space/place for co-creation. These elements influence the knowledge generation and practical innovation of Living Labs through dynamic interactions of participation, promotion, and organization.

Co-planning

Co-planning focuses on the planning phase of the co-creation process within a Living Lab. It specifically refers to the process by which multiple stakeholders collaborate to discuss, make decisions, and develop action plans before project implementation, emphasizing collaboration, communication, and knowledge sharing. Karlsson et al. (2020) propose that co-planning is achieved through the mechanisms of "patching" and "cogitation." Patching refers to extending the findings of a Living Lab to other contexts, while cogitation involves reflective design to address complex challenges. In urban planning, co-planning often takes the form of workshops, prototyping, and iterative testing. For example, a Living Lab in the Hegewarren region facilitated collaboration between residents and experts to jointly design future development plans for the region (Rădulescu et al., 2023), including multiple stakeholders such as: landscape architects, engineers, recreation and tourism, water sports actors and political actors through workshops. As a participatory mechanism, co-planning attempts to bridge expert and lay knowledge but is often constrained by institutional filtering processes that determine which ideas are deemed "implementable" or "pragmatic" (Palla et al., 2024). In practice, certain proposals are deemed impractical or unaligned with bureaucratic timelines and resources (Palla et al., 2024). In such cases, the shift from participatory inputs to formal interventions may involve negotiation, compromise and reframing or depoliticization. Furthermore, organizational structures and lack of political support can limit the flexibility of co-planning, particularly in highly hierarchical government organizations, as exemplified by the GovLab Austria case (Haug & Mergel, 2021).

While co-creation and co-planning offer significant potential, challenges exist. Steen et al. (2018) highlight it risks shifting public service responsibility onto citizens. Ansell & Torfing (2021) further argue that since wealthy and highly educated citizens are more likely to participate, co-creation can reinforce inequalities and lead to tokenism. Additionally, communities assess feasibility based on local knowledge and pressing needs, but these perceptions often differ from the structural and financial constraints faced by governing institutions (Few, Brown & Tompkins, 2007). They believe this discrepancy can ultimately create a false sense of inclusion. On a practical level, co-creation is also challenging. Implementation obstacles often include administrative resistance, poor inter-governmental coordination, and self-doubt of participant. More commonly, many co-creations attempt struggle from the outset, their goals often hindered by administrative reluctance to delegate power, a lack of coordination within government (Ansell & Torfing, 2021). Support from government officials is crucial, providing the necessary resources (Tõnurist et al., 2017; Chronéer et al., 2019). More importantly, Whicher & Crick (2019) emphasize that top-level support confers legitimacy on the laboratory within the organization. While sufficient financial resources are widely considered essential for the survival of a laboratory (Chronéer et al., 2019), a small budget is not always a barrier and can actually inspire participants to find creative solutions (Haug & Mergel, 2021). What's more, co-creation has been shown to be an iterative process that cannot be fully planned in advance. Thus, flexibility, adaptability and change factors are essential in the co-creation process (Rădulescu et al., 2023).

2.3 Theory of Change

The development of a Living Lab (LL) involves three interconnected phases: design, implementation, and evaluation (Friedrich et al., 2013). It begins with design, which includes contextual understanding and activity development. This is followed by implementation or putting those ideas into practice. The final phase is evaluation, which focuses on learning and improving outcomes. Because evaluation is an iterative process that occurs throughout the project lifecycle, it continuously informs the other phases, leading to significant overlap rather than a linear progression. Therefore, a Theory of Change framework can be a useful device for understanding how these iterative processes contribute to the overall objectives of the Living Lab and to track its progress towards achieving its intended impacts, involving some form of social change (in the case of La Jonction, experiences of comfort in periods of summer heat).

2.3.1 The Origins and Composition of ToC

Theory of Change (ToC) originated in the field of project evaluation in the 1960s. Initially based on logic models, it was used to depict the causal pathway from input to outcome. In the 1980s, scholar Carol Weiss promoted the concept of "theory-driven evaluation," emphasizing the identification of the hypothetical mechanisms underlying interventions (Weiss, 1995). In the 1990s, ActKnowledge and the Aspen Institute formalized it, developing it into a participatory tool for community development and social change (Connell & Kubisch 1998). In the 2000s, ToC became widely used in the nonprofit and international development sectors, integrating it with logic models, results-based management, and systems thinking, emphasizing long-term outcomes and systemic complexity. Vogel (2012b) highlights the accessibility and practicality of the ToC approach for diverse development organizations, ranging from grassroots initiatives to donor agencies, becoming a foundational framework in the fields of social impact monitor, program evaluation, organizational development, and strategic planning (Herweg & Steiner 2002, Oberlack, et al., 2019). In recent years, ToC has further adapted to complex and dynamic situations, emphasizing flexibility, iteration, and multi-stakeholder participation, becoming a core method for global change planning and evaluation. It has seen increasing adoption in interdisciplinary sustainability research (Belcher et al., 2020; Oberlack et al, 2019; Schneider et al, 2019). Forbat et al. (2025) first proposed a LL evaluation framework based on the Theory of Change (ToC) and demonstrated its advantages in the field of Living Labs. It addresses the limitations of traditional evaluations by providing a structured causal pathway and explicit intervention hypotheses. The ToC not only documents outcomes but also explains their causes and the interaction of contextual factors. Its participatory design integrates multi-party knowledge, strengthens stakeholder engagement, and fosters the formation of a shared vision for change. Furthermore, the iterative nature of the ToC allows for mid-project adjustments, which is particularly important for experimental interventions in LLs. Therefore, the ToC offers a more robust and operational evaluation approach, overcoming the fragmented nature of existing frameworks.

ToC is a stakeholder-driven approach where participants collaboratively define the project's causal pathways, ensuring consensus on anticipated changes and implementation strategies (Forbat et al, 2025). Its essence is a comprehensive description and illustration of how and why the desired change occurs in a particular context. Many literature and case studies on Theories of Change reveal diverse approaches to their construction and presentation, resulting in varying understandings of their components. However, the most common key components include "activities", "outputs", "outcomes", "impact" and "generic causal links". It focuses on

clarifying the causal link between activities and their desired outcomes. Mapping the "missing middle" to show how interventions lead to outcomes through structured, forward-looking planning (Forbat et al, 2025). A robust Theory of Change will also include "specific causal links", “assumptions”, “mechanisms" (Dhillon & Vaca, 2018). The last three elements help to clarify the necessary conditions for achieving transformative impact and the pitfalls to avoid. This adds depth to the theory, illuminates complexity, and enhances its practical utility. In addition, depending on the intervention's context and the need for greater detail, organizations may incorporate additional elements into their Theory of Change, such as problem statements, beneficiary needs, resources, processes, metrics, risks, perspectives, relationships, organizational operations, values, principles, and context (Dhillon & Vaca, 2018). Although stakeholder engagement is not explicitly incorporated as a formal component of ToC, the emphasis on specificity, context, and mechanisms inherently necessitates participatory processes. Stakeholder engagement thus operates as a foundational methodological principle rather than a structural element. In practice, the process of developing a ToC is intrinsically participatory, often involving stakeholders in defining desired outcomes, challenging assumptions, and co-constructing causal pathways. This collaborative approach fosters collective visioning, shared understanding, and alignment among actors.

Moreover, traditional ToCs often present a simplified, linear view of causality, linking one outcome directly to another. However, real-world projects are far more complex to achieve their objectives. Effective strategies frequently relying on multiple, simultaneous causal pathways. Dhillon & Vaca (2018) emphasis the necessity of including alternative strategies and various causal elements within robust ToC (direct/indirect effects, interactions, inhibitors, etc.). Furthermore, interventions are designed to achieve specific outcomes, but they often lead to unintended or secondary effects. Recognizing these consequences is an ethical obligation for program managers and evaluators, as including both positive and negative foreseeable effects in the Theory of Change enhances its quality and robustness. Discussing unintended consequences is crucial, as they can include unexpected benefits for individuals outside the target group or negative impacts. This detailed approach to causality moves beyond simple linearity to better reflect the intricate realities of project implementation and impact.

2.3.2 Construction and Application of TOC

Developing a ToC makes explicit the collective assumptions about how change will occur, aligning stakeholders around a common strategic intent (Annie E. Casey Foundation, 2024). This process unfolds through a structured, stepwise approach. Vogel (2012a) outlines the sequential stages and relevant elements that should be followed in a theory of change analysis. It begins with an analysis of the context in which the initiative operates, including the social, political, environmental, and institutional conditions, as well as the roles of other actors who may influence change. The second stage is to define the long-term change the initiative. It aims to achieve clearly articulating what impact is desired, who it matters to, and who will ultimately benefit. In the third stage, practitioners map the sequence of changes. It necessary a logical chain of intermediate outcomes to move from the current state toward the desired long-term impact. The fourth stage involves making explicit the assumptions that underpin each step in this causal chain. These include the drivers of change, the rationale behind chosen interventions, and the conditions believed necessary for success. Finally, a diagram and accompanying narrative summary are created to visually and verbally represent the logic of the intervention, capturing both the change pathway and the reasoning behind it.

This process not only clarifies strategy but also serves as a foundation for learning, adaptation, and evaluation.

Besides, Van Geenhuizen (2023) indicate that constructing a ToC employs both "backward-mapping" and "forward-looking" approaches, often iteratively applied throughout the project lifecycle. At the program level, ToCs emphasize working backwards for identifying necessary preconditions for achieving desired impacts. This helps reflect on opportunities and constraints within the change process and identify potential new activities and interventions. However, if the project has already been planned, the ToC process at the project level focuses on forecasting and analyzing the likely outcomes and potential impacts of specific interventions or outputs. What's more, constructing a ToC is a highly dynamic and iterative process, requiring multiple feedback loops and regular revisions. Each meeting focused on a single element of the ToC, avoiding attempts to construct a comprehensive, project-wide ToC in one time (Van Geenhuizen, 2023). Iterative development driven by data and stakeholder input allows for a more detailed and comprehensive understanding of causal pathways. This ongoing, feedback-driven approach helps keep the project aligned with its goals while adapting to new insights and changing conditions to maximize its impact.

The ToC has gained recognition as a planning and evaluation tool for complex interventions, particularly in sectors such as environmental and public health (Breuer et al., 2015). It allows project teams to articulate expected pathways of change, underlying assumptions, and indicators of success. Forbat et al (2025) pointed out that the ToC approach is particularly well-suited for LLs because it effectively integrates the interplay of various project characteristics (such as multi-stakeholder collaboration and real-world experimentation) across different phases. Its key advantage is its clear distinction between short-term outputs, medium-term outcomes, and long-term impacts, for example, from short-term knowledge production to medium-term behavioural changes and even long-term, systemic, sustainable transformation. This ensures that activities are aligned with project objectives and intended outcomes, preventing potential inconsistencies. Therefore, it can function as a reflective framework for revisiting objectives, identifying gaps, and adapting strategies during implementation. Assess the effectiveness of implemented strategies, identifying unforeseen challenges, and highlighting areas requiring adjustments. A well-constructed ToC not only provides a clear roadmap for developing and implementing interventions aimed at addressing complex social issues and enhancing community well-being but also serves as a dynamic framework for revisiting objectives and adapting strategies during implementation. The inherent flexibility of the ToC enables adaptation based on emerging evidence. The synergy between co-creation and multi-stakeholder engagement can develop dynamically throughout the ToC process (Forbat et al., 2025). ToC acts not merely as a static diagram or linear sequence of activities, but as a living document that evolves as new insights and evidence emerge. Ongoing monitoring and evaluation by multi stakeholders function as crucial feedback loops. However, Vogel (2012b) cautions against over-reliance on ToC as a technocratic tool, emphasizing the importance of integrating qualitative insights and maintaining ongoing dialogue. This holistic approach ensures that the ToC remains relevant and effective throughout the project lifecycle.

2.4 Research Gaps

While existing literature offers valuable insights into Living Labs, participatory adaptation, and ToC-based evaluation, several important gaps remain.

First, although many studies examine participation and co-creation in urban Living Labs, they often provide cross-sectional accounts or focus primarily on the design and experimental phases (Puerari et al., 2018). What remains underexplored is the planning phase itself, particularly how degrees of participation and the dynamics of interaction among multiple stakeholders unfold in this stage. Systematic empirical analyses of participation dynamics during planning are still limited, leaving a gap in understanding how Living Labs lay the groundwork for later implementation. Second, although the significance of institutional coordination and policy integration in Living Labs is well-documented (Willems, Kuitert & Van Buuren, 2022), the detailed processes and dynamics of co-planning remain comparatively underexplored. Specifically, how institutional actors negotiate, filter, or reshape citizen proposals during planning and translation into implementation is underexplored. Existing work often addressing broader power dynamics but lacking detailed empirical examination in LL contexts. Finally, there are calls for the adoption of ToC as an iterative evaluation framework in sustainability and adaptation research (Thornton et al., 2017; Oberlack et al., 2019), and recent research has begun to incorporate theory of change frameworks into living lab evaluations (Heiskanen et al., 2018; Falk & Walter, 2023; Forbat et al., 2025). However, few studies show how ToC functions as a mid-course corrective and reflective mechanism once interventions are underway.

Therefore, by focusing on the Jonction Living Lab's attempt to co-develop UHI adaptation strategies in Geneva, this study contributes to filling these gaps. It examines not only who participates and how, but also what becomes of participatory proposals, and how planned interventions were revised and adjusted to account for evolving realities and institutional constraints and demonstrates how a participatory ToC exercise can function as a reflective and corrective mechanism during implementation.

3. Methodology

3.1 Research Approach

The Living Lab functions as a real-world experimental and transdisciplinary space, where researchers, public authorities, residents, and urban designers collaboratively engage in the co-design of urban heat adaptation strategies. Given this complex and multi-actors setting, a flexible and embedded methodology was required. This study adopts a qualitative single-case study approach, grounded in an exploratory and interpretive research paradigm. The aim is not to test a hypothesis but to explore and interpret the complex and evolving participation dynamics and design evolve during the planning and implementation phase of the Jonction Living Lab. The qualitative approach is suitable for examining subjective meanings, stakeholder interactions, and contextualized processes that cannot be reduced to quantifiable variables. Case studies are particularly suited for uncovering in-depth contextual processes and are widely used in urban sustainability research (Yin, 2014). The case study design allows for a deep, context-sensitive investigation of the Living Lab as a bounded yet evolving real-world setting. Rather than treating the case as static, it is treated as a processual and variable research.

When dealing with complex issues such as the urban heat island effect, relying solely on knowledge from a single discipline is often not enough to provide feasible solutions. The integration mechanism of trans-disciplinary science is to incorporate knowledge from fields such as sociology, ecology, and urban design into the innovation process together with local knowledge, life experience, and cultural norms, thereby enhancing the adaptability and feasibility of the solution. In line with the principles of transdisciplinary research, problems are jointly identified, goals are defined, and solutions are designed within multi stakeholders (Lang et al., 2012). this study places emphasis on joint problem framing, the integration of diverse knowledge systems and reflexivity. The research process itself is understood as a form of collaboration between academic and non-academic actors, where scientific insight and practical relevance co-evolve. This methodological stance informed both the research design and data collection strategies, privileging open-ended engagement and iterative interpretation.

3.2 Case Study Context: The Jonction Living Lab

This research is situated within the context of the Jonction Living Lab in Geneva, Switzerland. This Living Lab promotes a transdisciplinary initiative aimed at developing strategies for adapting to urban heat, saving energy, and improving the well-being of residents. Such initiatives are particularly crucial in neighborhoods facing environmental pressures and social complexity. The Jonction district perfectly exemplifies this complexity. This district, located at the confluence of the Rhône and Arve rivers, is a densely populated, socially mixed urban area that experiences significant urban heat island effects due to limited vegetation and a high concentration of impervious surfaces. Meanwhile, many faculties of the University of Geneva are also located here. Given these environmental and social conditions, Jonction was selected as a pilot site for experimenting with locally grounded, inclusive urban cooling strategies. Furthermore, this Living Lab operates as an integral part of a broader academic and governmental initiative. It forms part of the SWICE (Sustainable Well-being for Inclusive Communities and Environments) research program, supported by the Swiss Federal Office of Energy and coordinated by EPFL. The SWICE framework actively promotes citizen engagement, inter-institutional collaboration, and sustainability transitions,

making it an ideal context for studying participatory dynamics in practice within the urban cooling initiatives.

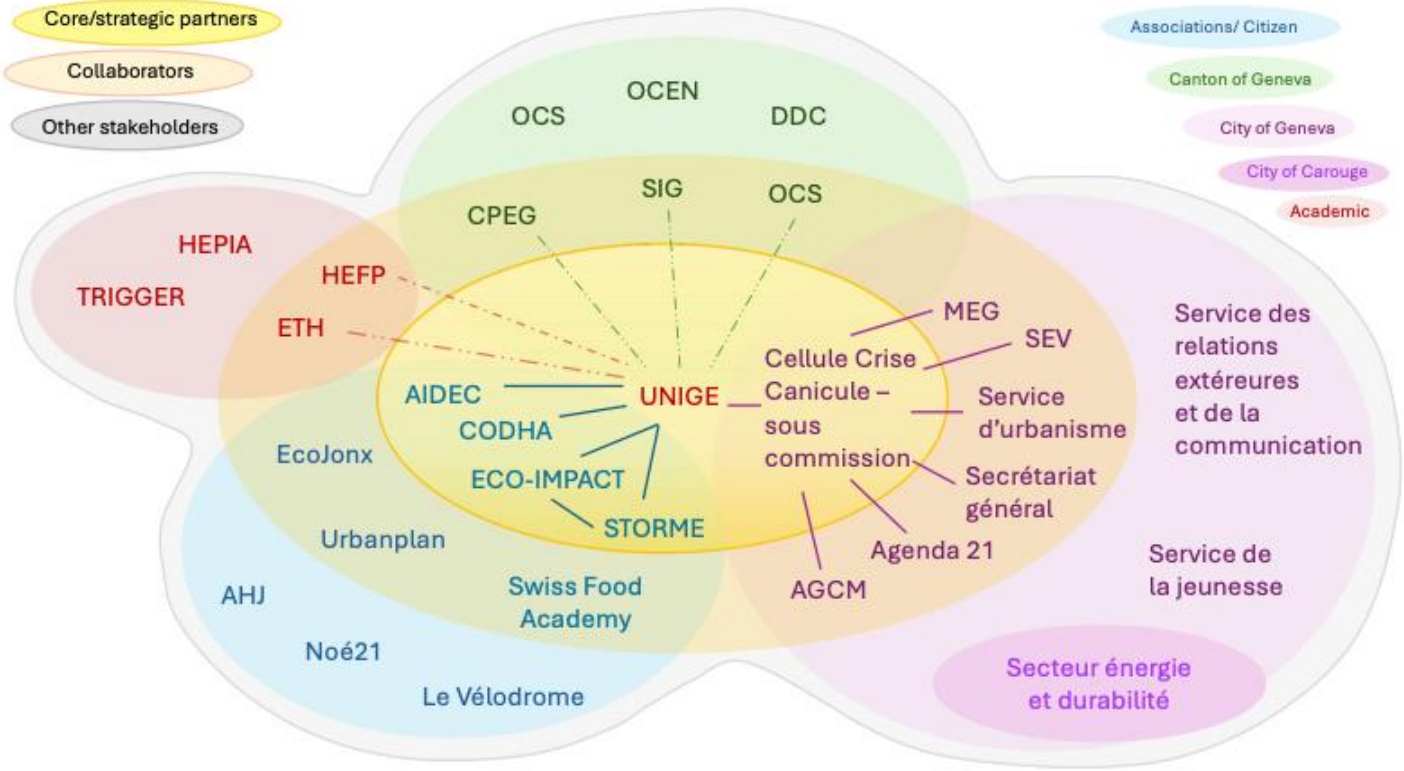
A field walk in August 2023 collected data on road temperatures, marking the beginning of the Living Lab and paving the way for the co-planning phase that followed. The two planning workshops in October and November 2024 marked the start of the co-planning phase for the Living Lab. The first workshop was about common problem framing in relation to urban heat in the Jonction, acknowledging the diverse perspectives of stakeholders, despite the universal experience of thermal discomfort. The second workshop aimed to identify solutions for the Jonction's heat challenge, centering on four key themes: mobility, lifestyle rhythms, specific places, and population diversity. Workshops offered opportunities for co-design across multi stakeholders, facilitated collaborative framing of the urban heat problem, and successfully generated a range of ideas (10 proposals). City meetings from January to May 2025 helped translate participatory proposals into prioritized interventions that could be implemented in the short term. Priority interventions were further narrowed down to planned interventions and facilitated their implementation. A theory of change workshop in June, among core team members, to help evaluate, monitor, and adjust planned interventions in the implementation phrase, monitoring and adjusting them, and collaboratively building a pathway for systemic change. The Table 1 showed the key participatory events during the planning and implementation phrases.

Table 1: Overview of Jonction Living Lab Events

Date	Event	Main Participants	Nos	Key Topics
Aug 2023	2 Field Walks	Residents, Researchers	15	Data collection Identification of heat-prone areas
18 Oct 2024	Co-creation Workshop 1	Public institutions, Residents, Urban designer, Researchers, Associations, Energy providers, SWICE team, Municipal actors, Housing cooperatives	21	Frame the problem of urban heat Lived experience sharing
13 Nov 2024	Co-creation Workshop 2		25	Finding solutions to address the problem of urban heat
Jan-May 2025	City-Level Meetings	Municipal departments of City of Geneva	6-13	Feasibility of implementation Integration with institutional activity
7 May 2025	Workshop 3	Residents from the Quartier de la Jonction	17	Create a map of cool spots and routes Share tips and tricks for staying cool Test personal cooling equipment
14 May 2025	Workshop 4	youth aged 12–20 from the Quartier de la Jonction	10	Mapping comfort levels for outdoor activities Identify and categorize heatwave challenges Propose creative solutions Evaluate cooling materials
June 2025	Theory of Change Co-construction Workshop	The core team of the la Jonction Living Lab	8	Reflect pathways from participatory insights to implementation scenarios and long-term vision

During the planning and implementation phases, a multi-stakeholder and multi-layered network was involved. This network included local residents, housing cooperatives, associations, urban planning firms, municipalities, cantonal governments (and their energy companies), as well as federal government services and Swiss higher education institutions. Figure 1 provides a visual representation of the Living Lab's organizational structure, illustrating the currently active stakeholders and their relationships.

Figure 1: The Jonction Living Lab Stakeholder Structure Model



The Jonction Living Lab's core team, comprised of both academic and professional members, fosters its ongoing operation and development through regular communication. The academic members, consisting of a professor, a researcher, and several master's students, form the UNIGE SWICE team, contributing research and coordination capabilities. The professional members, Eco-Impact and STROME, provide applied expertise and a practical perspective. This core team serves as a bridge, coordinating the various stakeholders and maintaining project momentum.

Overall, the Jonction Living Lab was selected as a case study due to its complex, evolving, and multi-actors' nature. The diversity of stakeholders and the long duration of the process allowed us to observe the dynamics of engagement unfolding over time rather than in isolation, which offers a unique opportunity to examine the challenges and possibilities of co-design and co-planning in real-world urban settings. By focusing on this case study, the research aims to generate insights from an analysis of participation dynamics and design evolution within the real-world context of a living lab experiment in urban open spaces. Therefore, the central research question is: How do participation dynamics and designs evolve during the planning and implementation phases of the Jonction Living Lab, from the core team to multi-stakeholder engagement, in the context of urban heat island mitigation?

The study operationalizes this central research question through three interconnected sub-questions, each corresponding to a distinct phase of the Living Lab process:

- Sub Q1: What were the degrees of participation and dynamics of various stakeholders during the two planning workshops?
- Sub Q2: How did the co-planning process shape the evolution from initial participatory proposals to planned interventions?
- Sub Q3: How can a theory of change be used to assess and reflect on planned interventions during implementation through workshop and follow-up meetings with the core team?

To answer all questions, the research compares the early-stage documents with the later feedback and changes suggested by stakeholders. Sub Q1 is explored through field observations and stakeholder interviews, reviewing engagement levels and interaction patterns. Sub Q2 assessed how participatory inputs from the City of Geneva translated into concrete intervention plans through documentary analysis and interviews. Sub Q3 examines planned and implemented interventions, intended outcomes, and reflective adjustments through ToC workshops and follow-up meetings with the core team.

3.3 Data Source

Given the complex, interactive nature of urban living labs, a multi-method data collection strategy was implemented to ensure methodological rigor and depth of analysis. Yin (2018) underscores interviews as a foundational and indispensable method for qualitative data collection, given their capacity to yield rich, context-specific insights. Yet, using different methods can not only verify the validity but also expand the scope and depth of understanding (Fielding & Fielding, 1986; Nightingale, 2016). Therefore, this case study primarily relied on three key data collection methods: taking detailed field notes, conducting interviews, and performing document analysis. Table 2 summarizes the different types of data collected for this study. The table highlights the number and nature of workshops, exploratory interviews, and documents analyzed, as well as their specific contribution to answering the research questions. Observation notes and workshop documents were analyzed by using ATLAS.ti software. All these methods could assist providing distinct but complementary insights into the research question and constructing triangulation. Employ data triangulation in favor of integrating the results obtained through different research methods. This provides a better understanding that a single approach may amplify or obscure (Cracco et al., 2024). Meanwhile, cross-verifying findings through multiple data streams helps to narrow problems of construct validity, as multiple sources of data provide multiple measures of the same phenomenon (Yin, 2014).

Table 2: Data Collection Summary

Data Source	Details	Quantity	Contribution
Workshops	Two major participatory workshops (Oct–Nov 2025) with diverse stakeholders	25 and 21 participants	Captured participation dynamics and degrees of involvement (Sub-Q1)

Exploratory Interviews	Semi-structured interviews with "Batman" and "Lightning"	1 interview (90 mins) 1 interview (60 mins) excluded for limited relevance	Provided contextual insights, clarified institutional roles, triangulated findings (Sub-Q2, Sub-Q3)
Documents	Workshop outputs, City meeting minutes, Theory of Change documents	17 documents reviewed	Traced proposal evolution, institutional filtering, and ToC reflection (Sub-Q2, Sub-Q3)

3.3.1 Field Notes

The field notes methodology was designed to capture the complex social dynamics of the workshops through a systematic yet flexible approach. The structured observation note-taking grid (Appendix 1) was carefully designed to balance immediate notational efficiency with long-term analytical consistency, enabling meaningful comparison across multiple workshops.

This grid tracked three interconnected analytical dimensions to holistically examine participation dynamics during the workshops. As a first step, we analyzed demographic representation to assess whether the process reflected a balanced and equitable inclusion of diverse participant groups. Document and analysis of participant composition by gender and institutional roles across two workshops. This aspect of the methodology is crucial for understanding how different social identities influence participation levels. In addition, the quality and depth of participation was evaluated using an adapted version of Arnstein's (1969) Ladder of Participation, operationalized into a four-tier coding system. It distinguished between different levels of influence: (1) direct control and facilitation of proceedings, (2) active debate and co-creation, (3) consultative information provision, and (4) passive information reception. At the highest level (Code 1), participants were classified as exhibiting leadership behaviors, such as facilitating discussions or making decisive contributions. Code 2 captured active engagement through debate and idea generation, while Code 3 denoted limited, consultative input. The lowest tier (Code 4) identified passive participants who listened without contributing. This ordinal scale enabled not only the categorization of individual engagement but also the tracking of shifts in participation hierarchies over time.

Furthermore, beyond individual behavior, observational metrics were designed to assess broader group dynamics. Firstly, a key focus of observation is the distribution of speaking time across genders, as disparities in verbal participation often reflect deeper participation asymmetries within the group. By documenting the frequency, duration, and context of contributions from male, female, this analysis extends assess how gender influences participation. Secondly, inclusion and exclusion patterns were documented through physical, behavioral and verbal cues (e.g., nodding, record, interruptions, frown), with notes on affected demographics and potential causes. Third, the dominance of specific narratives was tracked, including the sources of those narratives (e.g., institutional seniority, cultural background). Finally, observers recorded instances of counter-narratives or alternative perspectives, noting whether they were amplified or suppressed by the group. This structured multidimensional approach of observation note-taking grids support qualitative interpretation, thereby providing a comprehensive understanding and nuanced insights into participation dynamics at both explicit and implicit levels throughout the workshops.

Based on this methodological framework, the author adopted an observer role during the two workshops in 2024. Detailed field notes were maintained across all data collection phases, including formal and informal conversations, establishing a robust evidentiary foundation. This real-time documentation captured group interactions and non-verbal communication that formal records might otherwise miss. Additionally, critical and reflexive reflections within the field notes provided further insight into participation dynamics beyond formal processes. To further trace the evolution of participation, the author also took photographs with permission at different stages of the co-planning processes. The validity of these observations was then strengthened by cross-referencing them with the session photos.

3.3.2 Exploratory Interview

In addition to field notes, this study also employed exploratory interviews as a complementary method. Exploratory interviews are not intended to generate comprehensive or representative data but rather to clarify dynamics, provide contextual insights. As Stevens and Wrenn (2013, p. 53) note, “Exploratory research is in some ways akin to detective work. It involves a search for "clues" to reveal what happened or is currently taking place. A variety of sources might be used to provide insights and information, and the researcher follows where his or her nose leads in the search for ideas, insights, and clarification”. This qualitative approach emphasizes discovery over confirmation. They are particularly useful for capturing perspectives that may not emerge through workshop observation alone.

While exploratory research can flexibly employ a variety of methods to uncover insights, not all methods are equally effective or informative. A conversation with someone who has unique experience, expertise, or a relevant position is highly beneficial, could be one of the best ways to gain desired insights, hypotheses, and clarifications. (Stevens & Wrenn, 2013). Semi-structured interviews were adopted for this purpose, as they combine sufficient structure to remain aligned with the research objectives with the flexibility to pursue emerging themes and unexpected insights. This approach allows the researcher to use a guiding checklist (Appendix 2), and the order of questions can be adjusted based on the direction of the interview. While it also following up on unanticipated issues, encouraging interviewees to reflect on critical incidents and experiences. The interviewer conducts the research not to test a specific hypothesis or theory, but adopting an inductive stance, to address the research question or objective (David & Sutton, 2004).

In practice, one exploratory interview was conducted with a researcher coordinating the Living Lab (pseudonym “Batman”), lasting approximately 90 minutes. The insights gained from Batman’s dual role as both academic researcher and project facilitator proved valuable for contextualizing workshop observations, understanding how institutional actors engaged with the Living Lab, and reflecting in Living lab planning and running. The interview was audio-recorded with consent and transcribed verbatim. Another exploratory conversation with an associated expert (pseudonym “Lightning”) was carried out but later excluded from systematic analysis due to its limited relevance to the refined research questions. Thus, interviews in this study are positioned as an exploratory complement rather than a primary dataset, providing background understanding and helping to triangulate findings from workshops, meetings, and project documents.

3.3.3 Document Analysis

The document analysis focused on materials produced throughout the planning and implementation phases of the Jonction Living Lab, systematically examining three key categories of artifacts to trace participation dynamics and design evolution. First, co-design outputs during and after workshops were investigated, such as the heatwave challenge mind map visualizing priority action areas, comparative matrices positioning proposed interventions by cost and time feasibility, and detailed workshop synthesis reports. Second, meeting minutes from interactions with the City of Geneva were analyzed to trace how proposals developed in the participatory phase were later discussed, negotiated, or modified with institutional actors. Third, through Theory of Change (ToC) documents evaluated to assess alignment of implementation outcomes, original participation proposals and Ideal direction of change. It provided insight into the internal evaluation and strategic framing of the interventions during implementation.

The three types of documents, official institutional records, workshop-generated materials, and internal team reflections, were fundamentally different in nature, each serving a distinct analytical purpose. The institutional records provided a formal, high-level perspective on official decisions, while the raw, workshop-generated materials captured the unfiltered, creative energy of participation. In contrast, the internal team reflections offered a subjective and nuanced view of the project's daily challenges and learning processes. Despite these significant differences, their combined analysis enabled cross-verification and triangulation, which greatly enhanced the robustness of the findings. This tripartite approach collectively provided a longitudinal view of how participatory proposals evolved over time. It revealed how stakeholder inputs were progressively integrated or filtered through successive planning and execution stages, ultimately illuminating how collaborative design concepts can be transformed into practical urban heat island adaptation strategies. Consequently, this document analysis was essential for addressing Sub-questions Q2 and Q3.

In summary, by combining field notes (real-time behavior), exploratory interviews (subjective experiences), and documents analysis (formal records), this study mitigates the limitations of any single method. Exploratory interview provided subjective interpretations of events; participant observation captured emergent group dynamics; and document analysis offered solid evidence of planning processes and reflection. This tripartite approach not only enhanced authenticity, validity, rigor of study through data source triangulation (Tobin, & Begley, 2004), but also accommodated the Living Lab’s iterative, processual character by documenting both discursive and structural dimensions of collaboration.

3.4 Data Analysis

3.4.1 Case Boundary and Methodology Clarification

To capture the dynamics of participation and co-creation, a combination of data sources was mobilized. The methodological strategy was deliberately aligned with the three sub-questions, ensuring that each is addressed through the most relevant type of empirical material. At the same time, clarifications of case boundaries are necessary, since the Living Lab involved multiple events and stakeholders beyond the scope of this research. By explicitly delimiting the focus for each sub-question, the study ensures analytical depth while remaining transparent about its scope and limitations.

First of all, although the planning phase of the Jonction Living Lab included multiple formal and informal meetings, this study focuses on two major participatory workshops organized in end of 2024. These two workshops were chosen because they were the most engaging stakeholder interactions during the planning phase and were the most structured and diverse. By concentrating on these two events, the study can systematically capture participation dynamics and compare degrees of involvement, while acknowledging that additional meetings also contributed to shaping the planning process. Regarding stakeholder participation and interaction dynamics in the planning phase in the Sub-Q1, the study applied qualitative coding of workshop transcripts and observation notes. Arnstein's ladder of participation was adapted to assess the degree of participation, while interaction dynamics were analyzed through discourse and behavior analysis.

Secondly, numerous stakeholders participated in the co-creation of the Jonction Living Lab, and their interests and behaviors influenced the filtering of participatory proposals. However, this study focuses primarily on the role of public-sector actors, at the City level, in shaping and negotiating these proposals in the co-planning phase. This focus is justified for two reasons. First, institutional actors hold formal decision-making authority, and their negotiation processes largely determined which proposals could progress toward implementation. Second, the Geneva governmental bodies involved in this Living Lab have been particularly supportive of the project, which has generated extensive opportunities for observation and analysis. As such, while acknowledging that civil society groups, associations, and other stakeholders also played a role, this study delimits Sub-Question 2 to governmental filtering mechanisms in order to capture the institutional dynamics of co-planning. In terms of the evolution of participatory proposals in co-planning, this study explores this by tracing how proposals generated in the workshops are negotiated, reshaped, or filtered by government actors. This was complemented by document analysis and validation through interviews with core team member involved in the transition from planning to implementation.

Thirdly, while the implementation phase of the Jonction Living Lab involved multiple monitoring and follow-up activities, this study focuses on the first Theory of Change workshop conducted in summer 2025 and a series of follow-up meetings with the core team. More ToC workshops and interactions with various stakeholders will be held in the future, but due to time constraints and the authors' graduation schedule, these activities could not be included in this study. By focusing on this bounded set of implementation events, the research is able to provide an in-depth and systematic analysis of how the ToC framework was applied to assess and reflect on planned interventions. However, acknowledging that further activities will enrich or expand the findings beyond the present scope. In sub question 3, a participatory ToC exercise was conducted as a reflective and evaluative tool. Through a workshop and follow-up meetings with the core team, causal pathways were mapped, assumptions made explicit, and long-term impact clarified. This co-designed framework helped to evaluate planned interventions, identify unintended effects, and guide strategic adjustments.

3.4.2 Thematic Coding

All qualitative data were coded using an inductive thematic approach, including interviews, observation notes, and workshop summaries. The aim was to allow analytical categories to emerge naturally from the data rather than impose existing theoretical frameworks. This approach was consistent with the goals of exploratory research and helped to uncover the

dynamics of inclusion, equity, and participation during the planning phase of the Jonction Living Lab.

The coding process followed the six-stage framework for thematic analysis proposed by Braun & Clarke (2006). First, through the data familiarization stage, the researcher read through all the text materials several times to establish a holistic understanding and recorded initial observations and reflections through memo writing. Second, in the initial code generation stage, an open iterative coding method was used to manually code each transcript line by line, focusing on identifying units of meaning related to the research questions of participation dynamics, inclusion, and equity. This was followed by a theme identification stage, where the correlation codes were grouped into larger thematic categories, such as participation dynamics (Sub Q1), design evolution (Sub Q2) In the theme review stage, the entire data set was retrospectively checked to ensure that the identified themes accurately reflected the essential characteristics and cross-text patterns of the data content. The themes were then defined and named, and each theme was refined to clarify its connotation boundaries and establish discriminant validity between the themes. Finally, in the report writing stage, the selected text examples were placed in a dialogue with the theoretical framework and existing literature to provide an empirical basis for the research results and discussion chapters. It is also worth noting that although the six stages are arranged in a logical order, the analysis is not a linear process that advances through the stages (Byrne, 2022). In fact, thematic analysis requires an iterative approach that researchers repeatedly adjust (Braun & Clarke, 2020). Because new interpretation perspectives may be discovered during the analysis process, researchers often need to go back and optimize previous stages. Therefore, the six-stage framework should be viewed as a flexible guide rather than a strict rule to ensure that the analysis fits the data and research objectives (Braun & Clarke, 2020).

3.4.3 Theory of Change (ToC) Analysis

To address the implementation phase of the Living Lab and capture the core team's evolving reflections, data from a Theory of Change (ToC) workshop and related follow-up meetings were analyzed. The ToC method was used not only as an evaluation tool but also as a participatory reflection process, enabling core team members to articulate their perceived pathways of change, identify key assumptions, and assess the coherence between intended objectives and actual implementation steps.

The process of ToC data collection and analysis followed a structured participatory methodology: first, core members were divided into four small groups. Within each group, participants engaged in brainstorming sessions to independently construct their own preliminary Theories of Change. Each group worked on the same template, allowing them to concretely represent their reasoning and priorities. The template included not only the main components of the ToC: inputs, activities, outputs, outcomes and impacts, but also key dimensions such as external factors, indicator systems, theoretical assumptions and expected effects. Four theoretical models of change were independently recorded on paper to ensure that all viewpoints were fully captured. The second phase is a collective discussion, where the groups shared insights and clarified their respective reasoning processes. This peer exchange served not only to clarify each group's unique perspective but also to foster shared learning and critical reflection. In the last phase, each group's outputs and oral explanations were collected and organized, building interpretations inductively from workshop outputs rather than applying a pre-defined theory. Compared their different assumptions and strategic logics, identifying areas of convergence and divergence. This included a comparative analysis of the four group models across the main ToC components, as well as the identification of recurring

themes such as equity, policy engagement, material infrastructure, and knowledge sharing. After that, the four ToC models were synthetized into a comparative framework and further consolidated the materials into a unified Theory of Change framework that captures a shared vision while preserving diverse perspectives. The integrated version of the ToC was presented back to the team for validation and minor revisions, ensuring that the synthesis remained faithful to participants' contributions while offering a coherent strategic overview of the Living Lab's transformative ambitions. In the end, examining planned and implemented interventions, perceived outcomes, and reflexive adaptations by mapping the integration ToC framework against workshop outcomes to identify deviations and adaptations. Special attention is given to how the initial participatory proposals were revisited or reinterpreted once actions were executed, providing insight into the continuity between co-planned designs and actual field-based outcomes.

This analysis served to complement the documentary review and interview data by offering a structured window into how the team assessed their own work post-implementation. It was especially useful in addressing Sub-question 3, by providing insight into how interventions were retrospectively evaluated, how reflective learning took place, and how participatory intentions evolved once confronted with real-world constraints and institutional negotiations.

3.5 Ethical Considerations and Research Limitations

Ethical Considerations

The overall project, SWICE WP5 Open spaces, was submitted to the University of Geneva's ethics in research commission and given the green light in 2023. Given the complex social and institutional landscape of the Jonction Living Lab, ethical considerations were particularly salient. The project aims to involve diverse stakeholders in urban heat adaptation processes, requiring heightened sensitivity to potential participant vulnerability. Efforts were made to ensure that all voices were respected and that participants could withdraw at any time without consequence. This study was conducted in accordance with ethical research standards, ensuring transparency and respect for all participants. Prior to engagement, individuals were informed of the academic objectives of the research and written, or verbal consent was obtained for interviews and observational data collection. The inherent tension between obtaining rich qualitative data and protecting participant welfare arises when interviewees, in the flow of dialogue, share sensitive information they may later regret (Alshenqeeti, 2014). To address this, all collected data were kept strictly confidential and anonymized, except in cases where public-facing actors were explicitly referenced with their consent.

Reflexivity was maintained as a continuous practice to minimize the influence of personal biases on data interpretation. Field notes were written with explicit attention to the researcher's positionality, including how their presence may have shaped participant dynamics. Observations made during workshops and city meetings were consistently non-intrusive and contextualized with consent.

Given the language barriers, digital language tools such as DeepL and Google Translate were occasionally used to clarify sentence structure, improve expressions, and assist with translation between French, English, and Chinese. Additionally, Paper Digest and OpenAI's ChatGPT were used in a limited manner for brainstorming and locating relevant academic documents. These tools did not contribute to source collection, data gathering, or data

interpretation, and played no role in the participatory process. All substantive content was drafted and critically revised by the researcher to ensure accuracy, originality, and adherence to academic standards. Disclosure of their use is made here in the interest of transparency and academic integrity.

Research Limitations

As a qualitative, exploratory case study, this research prioritizes depth and contextual understanding over generalizability. The findings are inherently shaped by the institutional, cultural, and political context of the Jonction neighborhood in Geneva, and should not be uncritically extrapolated to other urban settings or Living Lab initiatives.

In addition to the case-specific focus, another limitation concerns the exploratory interview. This study conducted an exploratory interview with key member of the Living Lab, which is valuable for clarifying certain dynamics and generating insights but cannot be considered representative data in themselves. Other relevant voice, such as municipal official (e.g., Cat women) or core contributor (Wonder Women), could not be included due to time constraints. As a result, the perspectives captured may not fully represent the range of voices involved in the Jonction Living Lab. To address this limitation, exploratory interview insights were complemented with project documentation, observations, and informal exchanges (e.g., emails), which helped to contextualize findings and reduce the reliance on interviews alone. Efforts were made to triangulate data sources, which partially compensated for the limited coverage. However, participant observations, exploratory interview and documents review may remain a possibility of observer and interpretive bias. This subjectivity was partially mitigated through reflexive practice and validation with project stakeholders, but it cannot be fully eliminated.

Finally, as the study focused on the co-design and planning phase, only a limited range of stakeholders were accessible for interviews within the research timeline. In particular, some public officials and association groups could not be reached, which may have reduced the comprehensiveness of the participatory analysis. Future studies could extend the scope to include these actors and evaluate long-term implementation outcomes.

4. Results

4.1 Levels and Dynamics of Stakeholder Participation

To answer sub question 1, this section analyzes the levels and dynamics of stakeholder participation based on empirical findings from two planning workshops at the Jonction Living Lab. The analysis focuses on two dimensions: (A) Degree of Participation and (B) Participation Dynamics. Variations in participation levels are categorized into four levels: "Being Informed" (A4), "Being Consulted" (A3), "Discussing and Debating" (A2), and "Making Decisions" (A1). Participation dynamics encompass gender and voice (Bi), patterns of inclusion and exclusion (Bii), narratives and counternarratives (Biii), as well as participation format and process (Biv). Overall, participation levels and dynamics varied across workshops and within them.

4.1.1 Participation as a Temporally Evolving Process

Workshop participation data revealed significant differences in the participant composition of the two workshops. The total number of participants in the first and second workshops was 25 and 21, respectively, with a male-to-female ratio of 9:16 and 10:11, respectively. Using the Quadruple Helix theory as a framework, we divided participants into four categories: academia, government, civil society, and business. Among them, civil society representatives had the highest participation rate (32% and 42.5%), followed by academia (28% and 24.5%) and government representatives (24% and 19%), and the lowest rate was business representatives (16% and 14%). It can be seen from Figure 2 that all industries are well represented, but the participation of the business community is low, which deserves further investigation.

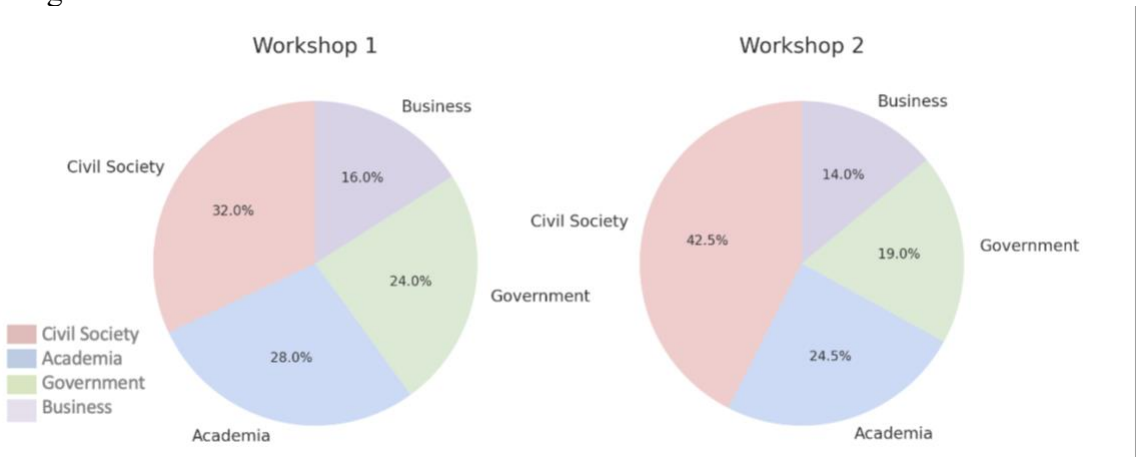


Figure 2: Stakeholder Participation by Quadruple Helix

In addition, although civil society representatives have the highest proportion, this does not mean balanced representation. A key finding is that vulnerable groups such as the unemployed, housewives, and people with disabilities are almost absent from the civil society group. This shows that although the participants are diverse to a certain extent, there are still deficiencies in inclusiveness, especially in the inclusion of vulnerable groups. In fact, the Living Lab's strategy is to contact relevant associations or representative entities to speak on behalf of vulnerable groups. For instance, organizations like AHJ and CODHA were considered to reflect the perspectives of local residents. However, “Batman" also reflected in

the interview whether these organizations can fully represent the masses and whether they are biased. He suggested that some people may not participate in local associations because they may feel that they are not legitimate or do not have a sense of belonging.

Meanwhile, "Batman" acknowledged the difficulty of connecting with these organizations. Although he has proactively contacted these groups many times, the results have not been satisfactory. "We try to get in touch with those more vulnerable groups population…they are hard to reach for many reasons." "We were in touch with primary school, not very successful...we're still in touch with elderly retirement home." The main barriers were organizational, and resource related. Coordinating activities required a lot of time and effort, so they chose to give up and focus on their own priorities. It suggests that the challenge was not simply willingness to participate, but the practical difficulty to mobilize time and resources for organizing activities. It is undeniable that despite the challenges, the core team of the Living Lab remains committed to actively reaching out to and attracting more diverse participants, with a particular focus on underrepresented groups, although there is still much room for improvement in recruitment.

For existing participants, participation levels evolved dynamically over the course of the workshop. Early in the workshop, many participants engaged in passive listening (A4) or occasional short comments (A3). However, as the discussion progressed, participation levels gradually increased, with the most active forms occurring in discussion and debate (A2), while a small number of participants reached the level of decision-making (A1) when mapping out spaces or summarizing proposals. This evolution in participation levels was particularly pronounced among participants of different genders and backgrounds, as detailed in the next section. Overall, across both workshops, participation levels gradually deepened over time, but "discussion and debate" dominated, which is completely in line with the design purpose of workshops.

4.1.2 Participation Dynamics: Who Speaks and How?

The engagement dynamics observed during the workshop revealed the complexity of stakeholder interactions. The analysis focused on the following aspects:

Voice and Gender

Gender differences in speaking patterns were evident but different in both workshops. In the first workshop, men generally spoke more frequently and proactively than women. In the early stages of the workshop, female spoke less, particularly younger women. However, women's voice increased over time. In the latter half of the workshop, more women began to actively participate and contribute their opinions. The second workshop presented a starkly different pattern. Overall, women consistently played a more active role in the discussions, demonstrating greater focus and persistence, while men were more likely to disengage. From the outset, women began to speak freely and enthusiastically after choosing their preferred topics. In contrast, male participation varied significantly. Some men discuss actively, while others remained passive listeners or were distracted and had less engagement. As the discussion progressed, they ultimately contributed their thoughts. Although the two workshops reveals that gender did influence speaking patterns, there was no one-sided suppression of voices; all voices were ultimately heard and valued.

Inclusion and Exclusion

The workshops demonstrated shifting patterns of inclusion and exclusion. Although some people often experienced temporary feelings of exclusion in the early stages, they gradually became included over time, particularly during informal discussions and later in the workshop. Observation notes suggest that initial exclusion may have stemmed from age or status. For example, in Workshop 1, while men and women working in urban and environmental fields boldly expressed their views, young women and students were excluded. In Workshop 2, when middle-aged women (members of the local residents' association) led the discussion, young men were marginalized. However, these exclusionary dynamics were often mitigated through informal interactions during breaks. For example, a shy young man who remained silent during the formal meeting actively engaged with others during the coffee break. Coffee breaks provided a pressure-free platform for exchange, fostering trust and the sharing of ideas. This informal exchange made it easier for marginalized individuals to be heard, fostering their confidence in participating in the later workshop discussions. This resonates with Batman's discussion of the differences between online and offline meetings. He argues that "informal discussions can occur before or after offline meetings. Interested individuals often stay after the meeting to continue discussing ideas... whereas on Zoom, once the meeting ends, everyone disconnects. The atmosphere is completely different." Therefore, online meetings lack a scalable social atmosphere, limit informal communication, and the depth of discussion and collaborative effect are significantly lower than offline meetings.

Narrative and Counter-Narrative

Narrative dynamics highlighted differences in individual experiences and asymmetries in discourse power. During the first workshop, when the table host "Superman" at Table One presented a map of hot and cold spots in the Jonction area, a counter-narrative immediately emerged. Some local residents questioned the map's validity and accuracy, arguing that its data did not align with their personal experiences. This revealed a deep tension between scientific or expert-driven narratives and residents' experiential, local knowledge. In the second workshop, the narrative tension became even more pronounced. A senior, middle-aged female resident dominated the discussion. While her facilitation initially helped structure the conversation, she overemphasized the feasibility and necessity of her own proposal and neglected to listen to others' perspectives. This ultimately led to the group's fragmentation into three informal subgroups, each articulating a different perspective. This demonstrates that participatory processes are not inherently harmonious, often revealing conflicting narratives and asymmetries in discourse power. Counternarratives and divisions are not signs of failure, but rather manifestations of diversity and natural features of inclusive participatory dynamics. Negotiation and the seek common ground while reserving differences following a dispute are essential components of co-creation.

Participation Formats and Process Influence Participation Dynamics

Different participation formats also had varying impacts on the dynamics and inclusiveness of participations. The most obvious was the different participation models employed in the two workshops.

The first workshop employed a "World Café" format to reach a consensus on the heat wave problem in Junction. The four tables had different themes, including 1) hot spots and cold spots; 2) barriers to community adaptation to heat waves; 3) social issues; 4) existing solutions. Participants first sat down randomly and started the first round of discussion

around the preset topic at their table. Afterwards, all members kept the established grouping structure and rotated in groups, moving to the next discussion table in turn to participate in the discussion of new topics. This structured rotation-based discussion ensures the stability of personnel in each thematic group and enables diversified dialogue on the topic through spatial transformation.

However, "Stargirl" revealed structural limitations in World Café Format in Synthesis of workshop 1. As a table host, she noticed that participants did not rotate through the same sequence of tables, leading to uneven knowledge baselines. Specifically, discussions on social dimensions of heat and spatial inequalities (Tables 2 and 4) sometimes lacked the foundational understanding developed in discussions of heat experiences and temporal-spatial variations (Table 1). This sequencing gap potentially reinforced unequal participation. Participants with prior knowledge were more likely to dominate the subsequent discussion, thereby undermining the depth and coherence of other participants' contributions.

In contrast, the second workshop employed an Ideas Fair format to discuss the vision of creating equitable access to cool spaces and promoting sustainable responses to heat. Specifically, the discussion set up four parallel theme tables, focusing on: 1) mobility, 2) specific zone, 3) rhythms of life, and 4) diversity. In the first round, everyone was free to write down their ideas on each topic within a fixed time. In the second and third rounds, they chose the topics they were willing to discuss in depth. The self-selected provision of ideas and discussions broke the fixed grouping mode of traditional workshops. Participants were not restricted by groups and could freely choose to join any table to give ideas or discuss according to their personal interests and expertise. This format broke away from traditional fixed groups and mechanical rotations, demonstrating greater flexibility and inclusiveness. Everyone contributed ideas in their own preferred format.

According to observational notes, some participants thought and wrote independently, while others worked in groups (for example, one elderly woman narrated, one middle-aged man wrote). Notably, even as the second round commenced, one man chose to complete the task from initial round first. He insisted on silently writing down all his thoughts on the four topics by side before engaging with the group discussion. All that show that the unstructured format of participation affords participants freedom in terms of space, time, and subjectivity. By empowering participants with full autonomy, it effectively enhances their sense of control and depth of participation. Participants can independently choose topics and partners based on their personal interests and expertise, contributing ideas and engaging in discussions at their own pace. This format not only respects participants' backgrounds and interests, but also fosters a dynamic and interactive atmosphere, fostering a stronger desire of engagement. This was confirmed in the observation notes: young and middle-aged women were significantly more active in speaking than in the first round of workshops, offering specific and creative suggestions such as "Summer Solidarity" and "Outdoor Cooking (Fresh Food Workshop)". These proposals are briefly mentioned here, and their content and development will be described in more detail in subsequent sections.

Furthermore, a noteworthy detail was the significant role that the refreshments and drinks provided at the workshop tables played in fostering a relaxed atmosphere. Participants naturally ate and chatted at the beginning and throughout the workshops. This seemingly formal arrangement actually had an unexpectedly positive effect on fostering a harmonious and engaging atmosphere. Thus, it fostered an environment that fostered collaboration and open communication, enhancing the vitality of participation. Last but not least, the table

host's behavior could directly impact on participant dynamics. An experienced table host not only guides participants to focus on the research topic but also encourages everyone to speak, preventing a single participant from dominating the conversation. For example, Superman, the table host at the first table, spent the entire fourth round being questioned by participant and explaining the source and methodology of the research map, failing to guide discussion on the research topic. In contrast, Wonder Woman, Batman, and Stargirl were better able to guide the discussion and foster a lively atmosphere. However, it is noteworthy that on one occasion, after leading the discussion at the "Rhythm of Life" table, Wonder Woman temporarily left her table to check on the progress of other groups. Lacking consistent moderation, the discussion stalled, preventing participants from engaging in in-depth conversation. People gradually left, leaving the table empty for approximately 10 minutes. It was only after Wonder Woman returned that several female participants proactively joined in with suggestions, revitalizing the discussion. A middle-aged man subsequently joined the discussion.

Overall, these observations suggest that participation levels and dynamics are a complex and fluctuating process, influenced by gender differences, inclusivity challenges, narrative style, and participation format and process. From a timeline perspective, participation is a process of gradual learning and unlocking. Many marginalized or silenced individuals don't lack the will; rather, they need interaction and time to guide and release their feelings. Exclusion isn't static; it can be reversed with time and appropriate guidance. Informal spaces for communication are a necessary and crucial platform. Future engagement model designs should more systematically consider these factors to enhance inclusiveness and equity.

4.2 Co-planning Shape the Evolution of Proposals

To answer sub-question 2, the minutes of the Geneva City meeting and the synthesis report of the second workshop were carefully reviewed and compared, together with the interview and analysis of Batman, to illustrate how the co-planning process shaped the evolution from initial participatory proposals of the workshop to planned interventions.

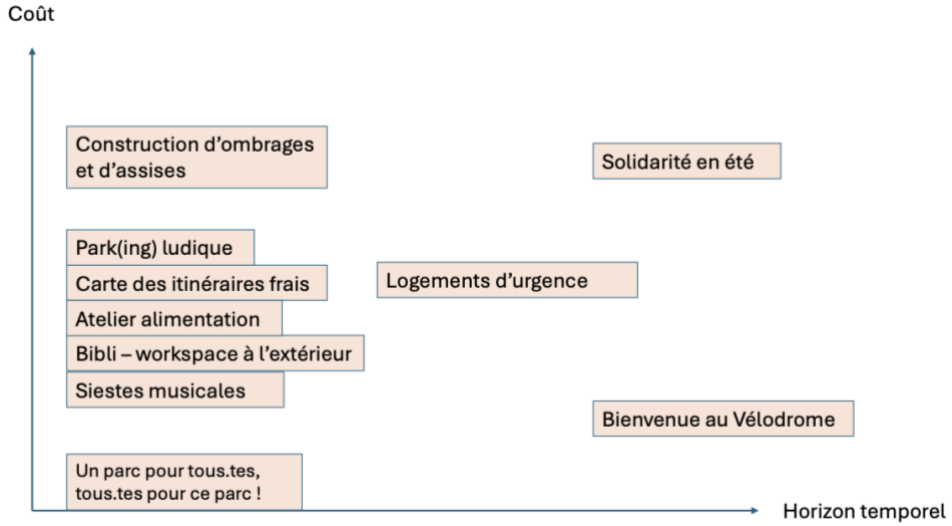
4.2.1 From Participatory Proposals to Possible Interventions

The synthesis report from the Jonction Living Lab's second workshop recorded ten original participatory proposals and a visual graph indicating where participants placed their ideas on the cost and time axes (Figure 3). These proposals spanned various temporal horizons and thematic categories, ranging from low-cost, short-term interventions to ambitious, long-term visions.

1. **Cool Route Map**: Mapping cool routes in the Jonction and Plainpalais areas.
2. **Outdoor Library Workspace**: Outdoor workspaces in parks.
3. **Playful Park(ing)**: Transforming parking spaces into recreational areas.
4. **Musical Siestas**: Distributing hammocks and organizing musical siestas in cool spaces.
5. **Shading and Seating Construction**: Co-building lightweight shaded seating.
6. **A Park for Everyone**: Creating a multifunctional park at Pointe de la Jonction.
7. **Welcome to the Vélodrome**: Greening and repurposing the Vélodrome underground corridor.
8. **Fresh Food Workshop**: Workshops on cool, sustainable, and local food.

9. **Emergency Housing**: Temporary shelters for those affected by overheated homes.
10. **Summer Solidarity**: A solidarity program for vulnerable populations during heatwaves.

Figure 3: Positioning of the proposed interventions



According to the minutes of the City of Geneva, the ten participatory proposals were reviewed several times by the UNIGE SWICE team and various City of Geneva departments in a series of meetings. Initially, the UNIGE SWICE team has maintained communication with a Geneva city official, whose pseudonym was “Catwoman”. She not only circulated the list of Living Lab proposals among the relevant municipal services but also played the key coordinating role. By convening and mobilizing different city departments, she enabled a series of co-planning meetings between the UNIGE SWICE team and the City of Geneva to move forward. Both in Batman's interviews and in his observation notes, Catwoman showed an extraordinary willingness to coordinate. It was like a "bridge" that helped build connections between academia and government. Catwoman has the authority to convene and connect these different services, thereby facilitating cross-departmental co-planning. However, it was unable to exert pressure on various departments and lacked the power to lead project development.

In January 2025, the UNIGE SWICE team held a preliminary exchange and discussion session on the heat wave crisis action plan with four government departments. It was discovered that some of the Living Lab's participatory proposals aligned with current or long-term urban planning initiatives. For instance, concepts like (5) Shading and Seating Structures were already incorporated into certain area designs, and (6) A Park for Everyone shared similarities with the Pointe de la Jonction Park slated for 2026. Consequently, these proposals required modification and adaptation to integrate with the existing urban planning framework. Batman also acknowledged this in the interview. He mentioned that after discussions with stakeholders in early 2025, leading them to realize that building upon existing ideas could ensure feasibility and would be beneficial both financially and practically, and in terms of relevance.

In February, a follow-up meeting was held between the UNIGE SWICE team and several relevant departments of the City of Geneva. The agenda not only revisited the ten proposals from the second workshop but also introduced several additional ideas. These ideas emerged from extended discussions during the workshop or were proposed by project partners or

derived from previous UNIGE research. All points were later labeled A to E in the meeting minutes: (A) preliminary feedback on the ten proposals, (B) promoting personal protective equipment (PPE), (C) guiding night ventilation, (D) proposing a fully shaded street in Plainpalais, and (E) redesigning Baud-Bovy Park.

Regarding 10 proposals, four of the original ideas were ultimately postponed as long-term priorities due to factors such as infrastructure requirements, administrative complexity, or the need for broader stakeholder support. These included (9) Emergency Housing, (2) Outdoor Library Workspaces, (10) Summer Solidarity, and (3) Playful Park(ing) transformations. Among them, the Playful Park(ing) initiative required not only a detailed feasibility assessment but also formal approval from the Canton of Geneva, a decision that falls beyond the authority of the City of Geneva.

Meanwhile, it was found that the municipality could not help with options B) and D) by analyzing Batman's interview. Regarding proposal B), Batman explained that "the municipal government showed reluctance to provide financial assistance in equipment procurement unless the items purchased strictly met its sustainability standards." However, these specific "sustainable" standards are not clear (for example, whether they require European production, avoid plastic, non-made in China, etc.), and there is a lack of formal purchasing guidelines. What's more, proposal D) proposed covering or misting the entire street to provide a wider cooling path rather than being limited to specific points. Batman mentioned that "this was intended to address the main pain point of citizens found in previous surveys, which was the difficulty in accessing cool paths in the city," or that people needed to be cooled not in specific locations but as they engaged in mobility, moving to and from cool spots. However, this proposal was ultimately not passed. He speculated that the reason might be that the plan was too complicated, too costly, or the project team did not plan sufficiently in advance to obtain the "green light" and financial support from the municipal department.

At a subsequent meeting in March, the UNIGE SWICE team and nine Geneva departments further discussed the six remaining participatory proposals. The meeting minutes from the City of Geneva indicate its potential to contribute to the implementation of these proposals. Based on their themes, specific collaborating departments and detailed next steps were identified, thus transforming them into possible interventions.

(1) Cool Route Map

City of Geneva inter-service coordination: with Department of Planning, Civil Engineering and Mobility (AGCM) about shading systems, misting, micro-oases, street crossing shades; With Urban Planning Department (URB) about mapping, in connection with mapping of cool places, etc.

(4) Musical Siestas

Inter-service coordination with Department of Children and Youth (DEJ) for operations - deckchair/parasol activities, Green Spaces Department (SEVE) for parks and paddling pool areas, Agenda 21/URB (mapping), AGCM (shading/spraying/micro-oasis systems).

(5) Shading and Seating Structures

Coordinate with AGCM. Pay special attention to Place Artamis and water use, such as fountains.

(7) Welcome to the Vélodrome

UNIGE need to submit a preliminary greening study to the City of Geneva departments for feasibility analysis: AGCM, SEVE and Department of Construction and Planning, Buildings and Architecture (DPBA)

(8) Fresh Food Workshops

Agenda 21 available for contacts for “fresh and cool” recipes. Location considered on rue Plantaporrêts or urban vegetable gardens

(6) A Park for Everyone

AGCM is assessing the relevance/interest of communicating about the upcoming project (2026-2027), alongside the workshops/events planned this summer by UNIGE.

Evidently, these six possible interventions demonstrated high feasibility and strong alignment with Geneva's urban planning goals, including enhancing public spaces, promoting sustainability, and addressing climate adaptation.

The reduction from ten initial proposals to six feasible interventions during the co-planning process underscores the positive influence and potential constraints of government departments on the proposals. The active involvement and input from the municipal government ensured that the selected interventions were not only feasible but also aligned with broader city-level urban planning frameworks. As described by Batman (interview), the co-planning process with the City of Geneva proved highly effective. Because it streamlined access to key resources (maps, infrastructure plans), fostered collaborative design, and ensured alignment between living lab's projects and the city's ongoing initiatives. Yet, unlike unrestricted participatory ideation, co-planning processes necessitates a rigorous consideration of practical limitations, including resource availability, budgetary allocations, administrative timetables, jurisdictional boundaries, and existing urban planning schedules. Consequently, by translating participatory outputs into institutional support and negotiating feasibility, co-planning process functioned as both an adaptive facilitator and a selective filter. This dynamic is precisely what Batman emphasized: "the living lab process without the workshops wouldn't mean a thing. All those workshops in the process without the support of the City wouldn't be very useful."

In fact, the selection of interventions wasn't solely determined by the government and core team. Batman's interview revealed that roughly half the initial proposals lacked sufficient stakeholder interest and support, precluding the possibility of implementation in this summer. Therefore, this selection process was a collaborative effort, reflecting the combined judgment of stakeholders, the core team, and government agencies. This highlights that stakeholder participation and the engagement of government services play equally crucial roles in the co-design and co-planning processes, with each fulfilling distinct yet interconnected responsibilities towards a common goal.

4.2.2 Further Selection and Adaptation to Shape Planned Intervention

While the City meeting identified six planned interventions to address urban heat in Geneva, the core team further screened and re-interpreted them based on feedback and reactions from multiple stakeholders.

During the interview, Batman commented that intervention selection depended heavily on stakeholder commitment. The core team assessed interest levels, effectively acting as a filter for proposals. While not fully transparent, this process ensured that only genuinely supported ideas proceeded, with unselected proposals retained for future consideration. Namely, (7) Welcome to the Vélodrome was recognized as a promising intervention but postponed due to jurisdictional issues. As explained by Batman, despite multiple invitations from the Living Lab to participate in the co-planning process, one department declined to attend. While other

participating departments found the proposal feasible, this department rejected it, citing the site's unsuitability for vegetation. Their refusal of assistance further contributed to the intervention's delay. Likewise, the logistical and responsibilities challenges facing the (4) Musical Siestas have limited its further development.

It can be argued that municipalities are more willing to share existing resources and projects with Living Labs rather than commit new resources based on participatory proposals. The best example was the proposal of (5) Shading and Seating Structures. Related departments agreed with the general idea; they did not fully accept all the locations proposed by the Living Lab. Despite rejecting the Velodrome placement, AGCM considered suggestions from the Living Lab, leading to expanded installations in Jonction compared to the previous year, such as those in Baud-Bovy Park. This demonstrates that municipal departments may integrate participatory inputs selectively, balancing them against existing priorities and administrative feasibility.

What's more, the Living Labs balanced their proposals with the Municipality's original plans, adapting some ideas flexibly to align with the government's vision. For instance: at Plantaporrêts Street, where the light shading structures were first installed by the Municipality, the Living Lab team took the chance to implement a mini workshop on energy consumption and the preparation of fresh fruit juices with Les Grands-Parents pour le Climate - GE. In parallel, the core team conducted a mini survey among residents to evaluate the light shading structures and how they think can be improved. During the survey, people have chance to exchange some knowledges about anti-heat stress. Thanks to the mini-survey, awareness of light shading structures, cooling measures have been raised and feedback to inform future improvements has been collected.

As Batman described with so many different departments involved, varying perspectives, interests, and objectives are inevitable. While a general consensus exists among participants, complete alignment on the specifics, the precise steps and phases of such a project, remains elusive. Further refinement is required. Therefore, after a process of screening and adjustment, the following four measures were finalized as planned interventions and short-term priorities for 2025.

(1) **Create and Distribute Cool Route Map**

(B) **Distribute Personal Cooling equipment (e.g., fans, sprayer, but also ice-cream)**

- Engage over 300 citizens in a dialogue about thermal comfort
- Sharing skills and tips and fostering practices changes

(5) **Support Shading and Seating Structure**

- City-led, with one case at Place Artamis funded by Living Lab
- Promote and Evaluate all Shading and Seating Construction

(8) **Hold Light and Fresh Food Workshops**

- Promote activities around cooling, like MEG's public cooling spaces

Only these interventions were viable to be organized and implemented in the short term, having practical execution and immediate benefits for the community. This result is very different from the positioning in the cost and time coordinate diagram at the workshop. It is obvious that most participants lack a big picture view and planning experience, which leads to a deviation from the true feasibility of their proposals. Batman also highlighted this interesting phenomenon in the interview, noting that participants, when asked to place their

ideas on a cost and feasibility chart, largely perceived their proposals as both affordable and highly realistic. In fact, some interventions have had to be postponed due to obstacles such as jurisdictional ambiguity and logistical complexities. These barriers indicated the tension between participatory ideals and practical constraints. Even well-supported participatory proposals can face delays when encountering institutional, technical, or operational complexities. The potential of proposals remains, but their postponement underscores the importance of aligning co-created ideas with administrative realities.

In Batman's interview, he summarized the entire screening process. About half of the initial proposals were too complex to be implemented in time for the summer of 2025. Thus, short-term interventions with strong feasibility are being promoted first. At the same time, he also mentioned that further activities are currently being tried through partnerships, which come from both suggestions from stakeholders and opportunities discovered by chance in informal conversations. "One partner is in the neighborhood where an association is offering activities for mostly for kids ... We still have to figure out. Additionally, this (University) library here is remaining fresh during the summer. And we might use one of the rooms they have... but this is not certain yet, we'll see. So, we might have a few extra activities that are not on this list."

Beyond the planned interventions on the list, the Living Lab also engaged in diverse collaborations with other actors. For example, MEG's Breath of Fresh Air Initiative, a response to heatwaves, shared many similarities with proposals such as the (2) Library Workspace Outside and (4) Musical Siestas. The Living Lab promoted MEG's public cooling spaces during the cool walks, thereby linking cultural institutions to thermal comfort strategies. Likewise, the CPEG waste workshop complements the fresh food workshop. Collaboration with CPEG provided an opportunity to raise awareness about waste sorting and sustainable practices. Make the city healthier, fresher, and cleaner during hot summers, reinforcing the Living Lab's commitment to both environment and well-being. These partnerships illustrate the Lab's emphasis on multi-actor collaboration and activity diversity. It also offered the opportunity of information collection and observation of residents' reactions. At the same time, these small-scale, short-term interventions not only provided immediate benefits but also served as testing grounds to collect feedback and observe residents' reactions. Only by better understanding needs and obstacles can the Living Lab propose more appropriate interventions in the future.

Overall, the planning phase of the Jonction Living Lab relied equally on citizen engagement, government services, and the Living Lab with its collaborators. On one hand, their combined efforts were crucial in shaping the proposals and selecting the final interventions. While participatory methods provided a crucial foundation for adapting to urban heat by leveraging public wisdom, their full potential requires sustained negotiation and iterative co-planning. This process not only shaped the intervention agenda by balancing citizen aspirations, urban planning priorities, and practical constraints, but also clarified the timing and feasibility of interventions.

On the other hand, equally important was the flexibility and of the Living Lab. Rather than relying on a single solution, the Jonction Living Lab pursued a combination of diverse and parallel initiatives. For instance, supporting city-led measures, using partner resources for promotion, informal exchanging with citizens. This diversity allowed different actors to contribute in different ways and created multiple entry points for engagement. Such flexibility ensures that even if certain proposals are delayed or face institutional obstacles, others can still move forward, keeping momentum alive and sustaining collaboration. It also

created opportunities for continuous learning and incremental improvement. In this sense, the co-planning process illustrates how participatory ideas evolve into feasible interventions through structured evaluation, stakeholder collaboration, and iterative and adaptive adjustment.

4.3 Evaluation and Reflection during Implementation – Insights from ToC

After a period of implementation, the Living Lab had a mid-term evaluation and reflection of the 2025 summer intervention to guide future direction. The primary approach used was a theory of change, which is also the key step in answering Sub question 3.

4.3.1 Divergent Pathways, Shared Goals: Comparison and Integration of ToC

As part of the Living Lab's participatory co-creation process, a Theory of Change (ToC) framework was collectively developed by the core team and systematically documented in the form of a visual logic model. All four groups set improving thermal comfort as the core goal to mitigate urban heat island effects. However, their long-term visions and expected pathways show significant differences. Each group used the typical Theory of Change structure: "Inputs → Activities → Outputs → Outcomes → Impacts." But due to their different dimensions of focus, various change pathways were formed (Table 3).

Table 3: Theory of change comparative framework

ToC Element	Group M&M	Group J&P	Group Y&L	Group N&M
Inputs	Focused on materials and infrastructure	Same as M&M Group but mentioned budget, team, and partners.	Same as J&P group, but added **flexibility and creativity**	Similar to J&P group
Activities	Similar to J&P group, but uniquely **emphasized understand local needs**, **media influence** and **collective learning activities**.	Focused on workshops, interviews, fresh walk, and distribution of personal cooling equipment.	Similar to J&P group, added **sensibilization activities**	Similar to J&P group
Outputs	Stressed **media visibility** (e.g., press coverage), satisfaction with cooling practice changes and **diversity of affected populations**.	Focus on knowledge of keep fresh **(information)**, improving cooling skills **(sensitivity)**, and using thermal comfort equipment **(materials)**	Similar to J&P group in **improve awareness of keeping fresh** and **knowledge sharing**	Similar to J&P group in developing knowledge, usage of material, but emphasized **partner commitment.**
Outcomes	**Standardizing good practices**.	Focused on **skills sustainability**, **systemizing devices**, and **addressing vulnerability**.	Highlighted **behavioral changes, comprehensive reporting** in public space (e.g., infrastructure use).	Emphasized **self-reflection, autonomous adaptation, expanding the scope of influence**

Impacts	Improved summer urban life, **health**, and **well-being**.	Similar to M&M group and additionally **reduce energy use** and **gain political support for climate mitigation.**	Similar to J&P group, highlighting its impact on **catalyzing policy shifts** and **gaining political support** to **ensure thermal comfort is inclusive and equitable**.	Similar to J&P group, added **institutionalizing good practices** and **organizing activities spontaneously by partners**

M&M group stood out for its emphasis on media strategy and visibility (or the role of the media in picking up on cooling tips and promoting them to a wider audience), and the importance of diverse representation of affected populations, focusing on improving urban life, health, and well-being during heatwaves. Meanwhile, J&P group incorporated systemic thinking and vulnerability, prioritizing both resident well-being and environmental issues. They linked outcomes to policy and infrastructure, highlighting the need for reduced energy use and proactive climate policies. In contrast, Y&L team took a more institutional and policy-oriented perspective, focusing on formal reporting and record and keeping promoting inclusivity and equity in thermal comfort. Additionally, the N&M group's emphasis on autonomous reflection in the process and partners' long-term self-driven behaviors, as well as the institutionalization of practice over time, reflects an understanding of the adaptability and spontaneity of change. Thus, this Theory of Change exercise clearly revealed the different understandings of mid-term outcomes and long-term impacts among the core members. This finding not only highlights the differences in perspective within the team but also provides a key basis for subsequent strategic adjustments and consensus building. By identifying these points of disagreement, we can design interventions more targeted, ensure the synergistic integration of different paths, and ultimately promote more effective change.

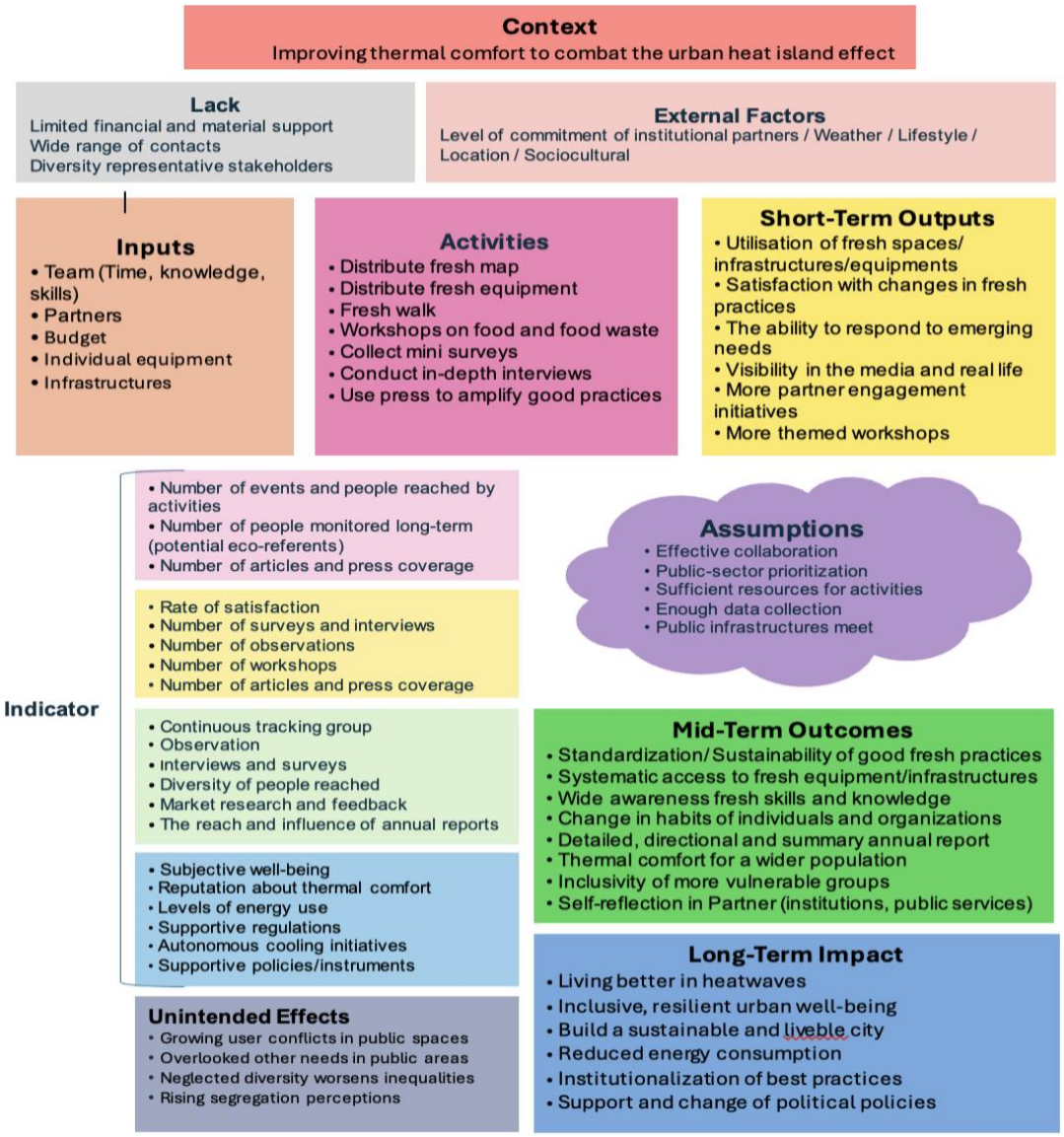
The common point is that all groups recognize that change is gradual. From enhancing individual well-being to building a healthy and liveable city requires step-by-step effort. There is also a high degree of consensus on the activities part of ToC, such as workshops, collect mini surveys, as well as distribution of fresh map and thermal comfort equipment. They all believe that the change path needs to combine material, awareness, and capacity dimensions, but with different emphases. Therefore, perspectives in terms of mid-term outcomes and long-term impacts are slightly different. Some groups focus more on quality-of-life improvement as the long-term impact. Others pay attention on institutionalization of good practices, climate issue and energy saving, or promoting more inclusive policy innovation. It may even involve spatial politics and the reconstruction of discursive power. Although the four pathways appear different, they are highly complementary and potentially synergistic. This shows that different core co-creators form diverse understandings of "change" based on their organizational roles, knowledge backgrounds, and values. We can take this opportunity to fill in the gaps, learn from each other's strengths, and improve planning. Generally, their goals of change go beyond short-term interventions. Behavioral shifts, structural changes, and institutional recognition are involved. The change process progresses from distributing cooling tools in the short term, to spreading knowledge about heat protection and improving individual well-being and behavioral change, and then to the long-term construction of comfortable environments to ensure the health and happiness of urban residents during summer.

Meanwhile, all groups developed indicators from activities to impacts to measure the evolution of change. Their selections were largely consistent across categories. Similar indicators, such as the number of workshops, surveys, or observations, were proposed to

measure short-term outputs. Long-term impacts' indicators were generally around improved well-being, reduced energy use, and supportive policies. This convergence suggests that despite differences in emphasis, participants shared a common understanding of how to evaluate progress. Moreover, in the Theory of Change exercise, core members also became aware that diversity, equity, and inclusion are not sufficiently visible in current participatory planning. Future conflicts over public space needs and feelings of exclusion may also arise. In view of the above-mentioned unintended effects, it may be necessary to include additional mid- and long-term indicators to enhance inclusion and equity, such as the expand the scope and population of sharing heatstroke prevention knowledge, the proportion of vulnerable groups reached, whether spatial reconfigurations considered feedback from diverse participants. These often-overlooked deficiencies or unintended effects more intuitively showed in the Theory of Change exercise. It also points out a better direction for future living lab.

In the end, synthesized the four ToC models into a comparative framework, and further consolidated the materials into a unified Theory of Change framework (Figure 4) that captures both the common goals and the diversity of pathways proposed.

Figure 4: Integration of ToC framework



4.3.2 Assessing Alignment of Planned Intervention, Participatory Proposal and ToC

Theory of Change model not only served as a reflection tool for evaluating the current alignment between activities and original participatory proposals, but also as a conceptual framework for structuring the team's understanding of desired change processes.

Planned Intervention VS. Participatory Proposal

The integration of ToC shows that the pathway of the Living Lab aligns closely with the participatory proposals produced in the first two co-created workshops and even goes further. Among ten participatory proposals, four of them are already included in the "activities" section: (5) promotion of shade and seating, (1) distribution of the Fresh Map, B) distribution of personal cooling equipment, and the (8) fresh food workshop. Together, these initiatives, particularly the first three, which have been implemented smoothly. It demonstrated clear consistency with the activities envisioned in the early co-creation workshops and subsequently reflected in the ToC. In addition, through mini-questionnaire and informal exchange, more than 300 citizens have engaged in conversations about thermal comfort, cooling tips, urban cooling design and well-being. It emerged as a significant activity in its own right, promoting citizen engagement and everyday behavioral change.

Planned Intervention VS. Theory of Change

Beyond its utility for retrospective analysis, the integrated ToC framework serves to illuminate significant disparities between the envisioned trajectory of change and its practical realization. A comparative analysis of implemented interventions against the desired direction of change reveals both intended outcomes and unexpected deviations, thereby enabling reflective adjustments. Consequently, realizing the expected outcomes and long-term impact of the ToC necessitates further efforts and enhanced alignment in several key areas. Notably, media outreach and collective learning are crucial for behavioral change and community resilience. While the Lab has already gained some valuable media exposure, broader knowledge-sharing activities are still in the planning stage and require further development to reach a wider audience. Moreover, while the importance of equity and inclusion was acknowledged during the ToC reflection, current interventions lack targeted strategies to reach vulnerable populations or to ensure that spatial adaptations reflect diverse user needs. Similarly, existing monitoring efforts largely focus on short-term participation metrics, with limited mechanisms in place to track mid-term or long-term shifts in behavior, wellbeing, or policy influence.

Theory of Change VS. Participatory Proposal

Additionally, the ToC analysis helped to enable the core team to evaluate and reflect on whether the Living Lab's current activities and future directions are aligned with the participatory proposals originally generated during the earlier workshops, or whether adjustments are needed. For instance, some creative proposals produced in Workshops, like the (7) Welcome to Vélodrome, (6) A Park for Everyone and (9) Emergency housing. These proposals are clearly medium-term or long-term priorities rather than short-term. They have yet to be explored from the current ToC architecture, despite their potential to contribute to the ToC's broader goals of improving thermal comfort and fostering well-being. It reflected a prioritization gap, where short-term, technically feasible interventions dominate implementation agendas. This gap suggests the need for adaptive planning and mid-course

corrections. Using ToC as an evaluative lens conduct regular mid-term reflections could help clarify which long term impacts and visions are being pursued. At the same time, identify gaps between implementation and expectations, and reorient activities toward a more coherent and correct trajectory.

4.3.3 Identified Priorities from ToC framework

During the subsequent meeting, based on the comparison and integration of the ToC framework, the core team identified three key areas that needed improvement. Discussions and preparations began for the activities that needed to be carried out this summer and next summer cycle.

First, the team discussed how to initiate knowledge-sharing activities on heatstroke prevention, acknowledging that these actions are essential to achieving the ToC's mid-term vision of collective learning. As part of the effort to enhance collective learning and address mid-to-long-term goals identified in the Theory of Change, the core team discussed concrete steps to initiate heatstroke prevention knowledge-sharing activities. A preliminary decision was made to synthesize the existing responses from the mini survey, in which participants shared effective heat mitigation practices from around the world. These collective insights will be compiled into a simple and accessible flyer, to be distributed both within the existing Living Lab network and to the broader public. This approach not only serves as a feedback mechanism for those already engaged in the participatory process but also expands the Lab's reach to new audiences, thereby enhancing diversity and inclusivity. By transforming participant knowledge into actionable initiative reflects a commitment to reciprocal engagement and positions local knowledge as a driver for climate resilience.

Secondly, the reorientation of the (8) Fresh food workshops was highlighted. This intervention has the benefit of raising awareness of climate-friendly practices, health and community well-being. However, due to a change in management at the school, the collaboration required more time for planning. It became one of the medium-term priorities, rather than the short-term priorities as considered in the co-planning. The core team has agreed to maintain contact with the local primary school throughout this summer, with the goal of gradually co-developing the workshop in a participatory manner. A larger workshop could be implemented in summer 2026 with the collaboration of Swiss Food Academy. However, two small workshops on fresh food were held in August 2025. One to produce fresh juice by pedalling a bicycle which already implemented once with partner of Grands-Parents pour le Climat – GE. The other is to teach children to make light and cool dishes, with Swiss Food Academy experts. By carefully planning the preparation and engaging both institutional partners and children, these activities aim to ensure that both educational and locally rooted influence, which fostering sustainable lifestyles and promoting collective learning. This reflects the alignment of the workshop's medium-term outcomes with the theory of change and will also help advance long-term outcomes related to inclusion and everyday thermal comfort.

Thirdly, there was an open conversation about the need to improve diversity, equity, and inclusion across all interventions. Although diversity, equity, and inclusion had been recognized as a cross-cutting value in earlier discussions, its operationalization remained limited. The team agreed that more intentional and targeted efforts are required to ensure that interventions reflect the needs of vulnerable and underrepresented populations, and to support the ToC's long-term equity and well-being objectives. According to the insights drawn from a

mini survey, the older participants reported significantly greater discomfort during heat events compared to younger individuals. It highlights the elders have heightened vulnerability to thermal stress. However, existing implementations had not adequately targeted this demographic. To address this gap, the core team proposed a new collaborative project with a local retirement home, aiming to distribute personal cooling devices, and to organize targeted knowledge-sharing sessions for them. This initiative could see as a concrete step toward operationalizing diversity principles embedded in the Theory of Change. It also reflected a shift from general awareness-raising to more needs-based, inclusive adaptation strategies, ensuring that those most at risk are not only acknowledged but actively supported through place-based and socially attuned interventions.

These reflections illustrate how the ToC was used not only as a retrospective assessment tool but also as a forward-looking planning instrument, enabling the team to adapt their strategy mid-course. By surfacing gaps between participatory ambitions and current practices, the process helped to re-align short-term actions with the Living Lab's broader transformative agenda.

5. Discussion

5.1 Factors Influencing Participation Levels and Dynamics

Two planning workshops at the Jonction Living Lab demonstrated how participation levels and dynamics were shaped by the interplay between antecedents and process design and form. Following Stokols et al.'s (2010) antecedent–process–outcome model, antecedents here refer to pre-existing factors such as institutional support, established networks, and prior collaborations, which significantly influenced who was mobilized and how interactions unfolded. In parallel, research has shown that process design and form strongly influence the depth and equity of participation. Specifically, the facilitation formats adopted (e.g., world café or ideas fair), the role of moderators in structuring discussions, and the degree of flexibility also directly shaped interaction patterns and inclusiveness (Krütli et al., 2010; Aliagas & Dragona, 2009). While informal co-creation and flexibility help lower barriers for less confident participants and foster more equal exchanges (Puerari et al., 2018; Vachon et al., 2013).

5.1.1 Stakeholder Diversity and Preconditions

The workshops brought together a relatively diverse group of stakeholders, a significant achievement for a Living Lab still in its planning stages. While some vulnerable or less connected groups (e.g., older residents and marginalized communities) were not yet represented, the observed diversity reflects the Quadruple Helix principle (Carayannis & Campbell, 2009), which states that academia, industry, government, and civil society contribute to the innovation ecosystem. The Quadruple Helix model is more local and impartial. Specifically, within the Jonction Living Lab, residents' perceptions and experiences of the urban heat island can serve as crucial inputs to urban design. Plus, as co-designers, they provide "local knowledge" about thermal perceptions, living needs, and other aspects, helping to avoid adaptation failures caused by standardized solutions.

Regarding the issue of relatively few industry participants being recruited, probably because UNIGE SWICE team used their existing networks to engage participants. As a result, representatives from academia, government, and civil society were more easily mobilized than those from industry. Stokols et al.'s (2010) antecedent-process-outcome model points out that such "taken-for-granted" pre-existing relationships are often overlooked but play an important role as antecedent factors. Using pre-existing networks not only help accelerate the recruitment of participants with a certain level of trust but also reduce the costs and risks of collaboration. Furthermore, this also ensures a diverse range of participants with a certain degree of disciplinary and experiential backgrounds. All these factors provided a strong foundation for vibrant participation and fostered higher levels of engagement.

At the same time, the organization of Living Lab activities depends on communication strategies that are not only precise but also comprehensive and sustained. Currently, much of the mobilization relied on ongoing exchanges, (e.g., daily phone calls, repeated informal meetings, and long-standing collaborations), which helped secure the presence of key actors. Nevertheless, there is still room for improvement in broadening outreach. The Living Lab has not yet fully developed ways of combining offline networks with more systematic online tools (e.g., QR codes, websites, or social media), which could help reach stakeholders beyond the existing circles, increase the breadth of participation and strengthen inclusiveness in the future.

5.1.2 Evolving Degrees and Dynamics of Participation

Regarding degree of participation, interactions during both workshops spanned multiple levels of Arnstein's (1969) ladder. Consistent with Stauffacher et al.'s (2008) concept of "hybrid participation," these workshops demonstrated blurred boundaries between different levels. For example, the mapping activity combined information, consultation, and co-decision-making within the same process. A notable trend is that the depth of participants' involvement continues to increase over time, which is consistent with Stauffacher et al.'s (2008) view. Participants typically began with passive listening and informing. As familiarity and trust grow, they gradually shifted to active exchange of ideas and negotiation. This aligns with Nyström et al.'s (2014) categorization of user roles, with participants transitioning from information providers to contributors and, in some cases, even co-creators during the workshops. While the overall process largely remained at the level of what Arnstein calls symbolic participation, as Fung (2006) notes, participatory consultation is sometimes more appropriate than pursuing the highest level of participation. The two workshops took place during the planning phase of the Junction LL project, where understanding various stakeholders' perspectives on urban heat adaptation and engaging in discussions about potential adaptation measures were crucial. Therefore, consultation and negotiation are the goal of this participation and is currently the most appropriate level of participation. This also explains why the appropriate level of stakeholder participation depends on project objectives (Tippett et al., 2007; Krütli et al., 2010; Menny et al., 2018).

Participation is not a neutral act, but rather one embedded in broader social structures. It is influenced by gender, age, profession, differences in personal experience, and asymmetries in voice. This supports O'Faircheallaigh's (2010) view that socially disadvantaged groups are actually the least likely to participate, because they lack the resources to participate and often find the processes involved unfamiliar and intimidating. Some younger participants seemed reluctant to interrupt or express their opinions in front of older, more confident speakers or participants who were more articulate. This early exclusion stems not from overt barriers but from subtle power dynamics, including familiarity with the context of participation, and differences in personality character. At the same time, some tense situations have highlighted the coexistence of knowledge asymmetries (Healey, 1997), such as how to reconcile expert-drawn maps with residents' experiential insights.

Participation dynamics are not static. Although exclusionary tendencies may emerge early in the participation process, they can evolve over time and with changes in form to become more inclusive. Informal moments (coffee breaks, private conversations) often rebalance the dynamic. A low-pressure environment makes participants feel more relaxed and willing to share ideas that are not fully organized or developed, and to build personal relationships, trust and psychological security. Quieter or less interactive participants get the chance to express themselves, thereby allowing them to feel more included in subsequent discussions and facilitating deeper formal collaboration later on. This echoes the views of Puerari et al. (2018), which informal co-creation is the 'behind-the-scenes' interaction that supports and complements formal collaborative processes. It lays the foundation for formal innovation and planning by building interpersonal trust and allowing ideas to flow freely.

In addition to informal exchanges, prior work underscores that flexibility in process design is crucial for shaping who speaks, when, and how (Vachon et al., 2013). This was evident across the two workshops. The first workshop adopted a World Café format that encouraged topic-focused dialogue, but participants always stayed with the same peers as they rotated. As a result, within-group dynamics were maintained over time, and those with greater

institutional confidence or authority tended to set the tone and lead the conversation. By contrast, the second workshop used a more flexible Ideas Fair in which participants self-selected topics and interlocutors each round, naturally re-mixing the groups. This lowered the communicate pressure for quieter participants, created new interaction opportunity and broadened the range of contributions. Consequently, women's participation was higher and more sustained in the second workshop. This reflected the view of Krütli et al. (2010) that participation methods should be tailored to context and may need to combine different techniques (e.g., re-mixing, open choice) to balance comparability with inclusiveness. In short, participation forms that are highly autonomous and flexible effectively lower barriers to participation, promote deeper and more equal interaction. Thus, it better unleash the potential for active participation.

Furthermore, the experience and behavior of the table host clearly influence participation. Aliagas & Dragona (2009) emphasized the importance of structured facilitation, specifically the role of the moderator in guiding discussions and maintaining engagement. They noted that moderators play a three-pronged role: explaining technical terminology to facilitate understanding for non-specialists; managing the conversational topics; and encouraging and motivating participants to speak. Therefore, table hosts need to guide and stimulate exploratory discussions among participants rather than simply recording discussion points and conveying the content of previous discussions.

5.2 Co-Planning as a Filtering and Adaptive Mechanism

Consistent with Almirall and Wareham (2008), the la Jonction's workshops became an open platform for diverse stakeholders to express local needs and propose interventions. This also echoes Bergvall-Kåreborn et al.'s (2009) emphasis on the value of diverse knowledge systems in driving innovation. This heterogeneity provided the workshops with a broad initial "creative space." It integrated local experiential and scientific knowledges, and fostered trust, understanding, and a shared vision among all parties, thereby strengthening enhancing intellectual capital and social capital (Rădulescu et al., 2023). However, as with other Living Lab projects, transitioning workshop outputs into implementable interventions requires not only scientific and experiential knowledge but also professional skills. Citizens and experts often lack understanding of the technical and organizational complexities underlying their ideas, leading to a frequent mismatch between their perceptions and the actual operational constraints. Consequently, urban planning projects with broad implications require the professional guidance and supervision of government departments. This intertwined dynamic between bottom-up citizen engagement and top-down institutionalization often emerges when participatory creation is combined with formal planning structures (Juujärvi & Lund, 2016). But the ideas gave an impulse, gave something for the city to 'react to', and helped to sustain what was already in the pipeline, and maybe to inspire new ideas for the future.

5.2.1 The Screening Process: From Proposals to Viable Interventions

The ten proposals initially generated by the workshop were screened and finally narrowed down to four feasible short-term interventions through a series of co-planning sessions with various departments of the City of Geneva. This screening process revealed both the positive impacts and potential limitations of the proposals from the government departments.

During the planning phase of the Jonction project, the core team members and municipal representatives jointly evaluated proposals based on constraints such as available budgets, existing project schedules, and regulatory boundaries. This process mirrors Palla et al.'s (2024) description of co-planning as a collaborative yet selective effort, acting as a "filter". Based on such as administrative capacity, resource constraints, jurisdictional authority, and established urban planning agendas. The outputs of the participatory workshops were evaluated against the realities. Representative one is the (3) Playful Park(ing) proposal. It was initially screened out of short-term priorities due to jurisdictional issues. Despite their initial feasibility, the (7) Welcome to the Vélodrome and (4) Musical Siestas proposals were ultimately hindered by a lack of internal coordination with the city representative responsible for coordinating summer extreme heat projects, as Ansell & Torfing (2021) also noted. This demonstrates that even promising proposals can be sidelined due to insufficient political support, underscoring the critical role of political capital in translating co-creation outcomes into practice (Rădulescu et al., 2023). The backing and resource provision of government officials are, therefore, crucial (Tõnurist et al., 2017; Chronéer et al., 2019). Therefore, this co-planning process can be considered an "exhalation" process led by government departments (Leminen, 2013). This suggests that bottom-up citizen initiatives must be institutionalized from the top down to gain legitimacy and feasibility. From another perspective, the transition from an "inhalation" process to an "exhalation" process facilitates the screening of feasible options, avoiding tokenism or ineffective participation (Kowaltowski, 2024).

Notably, the Jonction Living Lab showed that feasibility screening is not solely a top-down process within the municipal government. Stakeholder commitment also plays a parallel filtering role. Proposals with greater participant ownership and willingness to contribute, such as the (1) Create and Distribute Cool Route Map, are more likely to be retained. This finding reinforces Lang et al.'s (2012) assertion that the ultimate selection of interventions in interdisciplinary collaborations is jointly determined by institutional feasibility and the capacity for stakeholder engagement.

5.2.2 Adaptation and Evolution: Striking a Balance between Ideals and Reality

Co-planning is not only a screening process but also a process of adaptation and reinvention. It aligns participatory visions with institutional realities to ensure that the resulting interventions are both feasible and seamlessly integrate with the city's existing planning agenda.

As the participants' cost-time matrix and Batman's interviews revealed, workshop participants generally tend to underestimate costs and complexity when assessing the feasibility of proposals. A lack of a holistic perspective and planning experience leads to a skewed assessment of the proposals' true feasibility. This observation is consistent with research by Few, Brown & Tompkins (2007), who noted that community perceptions of feasibility often differ from governance realities. Therefore, co-planning effectively bridges this gap between idealism and practical constraints by drawing on the expertise of government and Living Lab core members. Rather than a simple linear, this process is a dynamic journey filled with trade-offs and negotiations, balancing citizen aspirations with practical urban planning constraints.

Drawing on Karlsson et al.'s (2020) framework, this process combines "cogitation" and "patching" to transform participatory insights into action. Specifically, Living Lab core members and government service departments work together to re-examine the gap between

original ideas and the city's established framework. This collaborative effort resulted in viable short-term solutions that are adjusted to meet stakeholder expectations and enhance feasibility. This reflective adaptation exemplifies "cogitation", while the integration of proposals into or alignment with existing municipal programs illustrates "patching". Logically, the city government prefers proposals that can be integrated with existing resources and programs over those that require significant new resources. Benefiting from "patching" and alignment with existing initiatives, some proposals were quickly implemented. Conversely, lacking the necessary "cogitation", others were postponed.

The most representative example is the proposal for "Shading and Seating Structures". Its transformation into a planned intervention involved both patching and cogitation. The Jonction Living Lab's participatory proposal, while generally aligned with the AGCM's vision and goals, differed in location and approach. However, facilitated by pre-existing trust and collaboration, as described by Stokols et al.'s (2010) antecedent-process-outcome model, leading to smoother negotiation and adaptation. Resolving through collaborative negotiations, the AGCM agreed to allow Living Lab to explore the possibility of installing shade structures at Place Artamis with CODHA and AIDEC, instead of directly involvement. Living Lab funded AIDEC to construct some shade structures at Place Artamis, in partnership with EcoJonx and COHDA. At the same times, Living Lab accepted the AGCM's pre-planned shade structures in other locations, taking on the responsibility of publicizing and surveying public opinion and feedback on these features. Thus, “patching” and “cogitation” allowed the participatory proposal to fit within existing project strategies, integrating the Living Lab proposal with urban practice. This process reinforces Batman's point in the interview: "Without the workshops, the Living Lab is meaningless; but without the support of the city government, all the workshops are useless." This emphasizes that only through ongoing consultation and iterative design can participatory ideals be transformed into impactful urban practice.

In addition, Batman repeatedly noted the constraint of financial resources during project selection. While resource limitations certainly posed challenges, they also inspired creative solutions, as Haug & Mergel (2021) suggest. The "juice bike" event, co-organized with Les Grands-Parents pour le Climate - GE, exemplifies this opinion. At minimal cost, it promoted energy conservation by reducing appliance use, especially heating equipment and advocated for fresh, local fruits to combat the summer heat at the same time. This resourceful approach extended to the overall project design, highlighting the flexibility of Living Lab leaders, adapting proposals to the current situation, while respecting participants' original ideas. This is consistent with Ansell & Gash (2012) mentioning the role of living lab leaders as enablers or catalysts of collaborative innovation.

In summary, the case of the Jonction Living Lab explained the filtering and adapting role of the co-planning process in transforming initial participatory proposals into feasible planned interventions. All of these adjustments to the participatory proposal process suggest that the co-planning of Living Lab projects requires flexibility, adaptability, and iterative design (Rădulescu et al., 2023), rather than a rigid adherence to the ideal form of the initial proposal. This also aligns with Menny et al.'s (2018) advice on balancing goals with the achievable scope.

5.3 Evaluation and Reflection During Implementation: How the ToC Drives Adaptive Planning

Analysis of the ToC exercise demonstrates how the Jonction Living Lab used participatory evaluation to consolidate progress and explore new directions during implementation. Consistent with the literature on ToC in Living Labs, the mid-term reflection in the summer of 2025 was not merely a retrospective assessment but rather an iterative mechanism for correcting direction and building consensus (Forbat et al., 2025; Breuer et al., 2015).

5.3.1 Integration of Multiple Pathways and a Shared Vision

By co-constructing the ToC framework, the four groups clarified their assumptions about causal pathways, and each envisioned the desired mid-term outcomes. This aligns with Vogel's (2012a, 2012b) perspective, who emphasizes that ToC serves as a tool to identify the "missing links" in causal relationships. The four groups developed unique ToC pathways using 'backward-mapping' or 'forward-looking' approaches. This supports Van Geenhuizen (2023)'s view that ToC serves as an iterative feedback tool, enabling project teams to flexibly combine retrospective analysis of prerequisites with forward-looking strategic planning.

As Batman said: "These overarching goals are almost shared objectives among participants. However, when it comes to the details of what the different steps or phases of such a project should be, I think there is not yet complete alignment. It requires further refinement". The ToC exercise helped core team members realize that, although they are all committed to mitigating the urban heat island effect, their understanding of 'change' and their expected pathways differ significantly due to their varied knowledge backgrounds, and values. The findings revealed that they focused, respectively, on media visibility and inclusion (M&M), systemic and policy engagement (J&P), institutionalization and equity (Y&L), and reflexivity and autonomous adaptation (N&M). This aligns with the view that successful projects often rely on multiple parallel causal pathways (Dhillon & Vaca, 2018). This multi-perspective approach is consistent with interdisciplinary principles (Lang et al., 2012), ensuring that the evaluation focuses not only on short-term interventions such as the distribution of cooling tools, but also on long-term systemic impacts including institutional buy-in, policy integration, and cultural changes in thermal comfort practices.

Despite divergences, the co-construction process of the ToC enables core team members to identify and integrate these diverse perspectives, synthesizing seemingly disparate paths into a unified framework. This fostering of a shared vision and alignment is the core strength of the ToC as a participatory design tool (Forbat et al., 2025). The ToC co-creation process transcends the outputs of short-term activities and fosters a collective consensus on the long-term impact of the project, touching upon deeper goals such as behavioral change, structural transformation, and institutional buy-in.

5.3.2 Identifying Unintended Consequences and Continuous Adaptation

The reflective process of the ToC not only reveals the intended causal chain but also enables the team to discuss unintended consequences and identify shortfalls, aspects often overlooked by traditional evaluation methods. This aligns with Dhillon & Vaca (2018), who argue that a robust ToC must acknowledge unintended effects and alternative strategies, and that planners have an ethical obligation to anticipate both positive and negative consequences. As a result, unintended consequences revealed potential blind spots in the project's spatial use in this ToC

exercises. Shading facilities pose the risk of exclusion from public space occupation or conflicting user needs, potentially leading to social tensions.

Furthermore, the limited participation of vulnerable groups and inadequate knowledge dissemination led core team members to recognize that current participatory planning and interventions may be insufficiently addressing diversity, equity, and inclusion. This finding echo calls in the sustainable development literature for integrating diversity, equity, and inclusion considerations into explicit medium- and long-term indicators (Belcher et al., 2020; Oberlack et al., 2019). In this sense, the Jonction Living Lab not only evaluates outputs based on practical constraints (Palla et al., 2024) but also broadens its scope to include extensive social groups and equity considerations. Therefore, the ToC can serve as a critical tool, helping the project team examine its limitations more comprehensively. Identifying these unintended consequences and potential flaws provides the project with a basis for strategic readjustment and adaptation to future challenges.

The ToC reflection workshop and subsequent internal meetings provided the core team with a structured opportunity to assess the alignment of planned interventions with broader project objectives. This evaluation process revealed some of the implementation gaps identified by Vogel (2012b) and areas requiring strategic reinforcement, particularly regarding medium- and long-term outcomes that had been insufficiently addressed during the early planning phase. Thus, subsequent meetings led to proposals for future activities to include knowledge sharing and collaboration with primary schools and nursing homes to enhance medium- and long-term indicators of inclusion and equity. This reinforces the dynamic adaptability of the ToC, namely, that it is a "living document". Its iterative nature allows for continuous evolution based on new insights and evidence, ensuring the project's continued relevance and effectiveness throughout implementation (Forbat et al., 2025). This process showed the reflective dimension of living lab evaluations identified by Friedrich et al. (2013), expressly that evaluation is not a final phase but rather an embedded learning cycle that reinforces shared planning and implementation.

However, the initial ToC developed by the Jonction Living Lab also had limitations. First, only one workshop was used to construct all components of the ToC, rather than multiple workshops where each component was discussed separately (Van Geenhuizen, 2023), potentially resulting in a lack of detailed analysis of each element. Furthermore, the ToC overlooked analysis of the operational context, including social, political, environmental, and institutional conditions (Vogel, 2012a). Finally, prior to the writing of this article, the internal team had envisioned iterating the ToC with additional stakeholders, but this had not yet been implemented.

Overall, the discussion of Sub-Question 3 suggests that the Jonction Living Lab ToC exercise is not merely an evaluation tool but rather an exercise in collective reflection and adaptive planning. It bridges implementation with strategic foresight, enabling stakeholders to align diverse pathways toward a more unified, flexible, and adaptable vision for change. It helps identify unintended consequences, and provides direction for future adaptive planning, ensuring the project's continued evolution and development. Thereby, it reinforces the role of living labs as interdisciplinary experiments in co-creation, learning, and iterative adaptation.

6. Conclusion

This study investigated how participation dynamics and designs evolve during the planning and implementation phases of the Jonction Living Lab, with a particular focus on multi-stakeholder interactions around urban heat island adaptation. Beyond answering the research questions, the findings also highlight the key strengths of the Living Lab approach and provide practical recommendations for improving its future development.

The analysis demonstrates several strengths of the Jonction Living Lab. First, it successfully mobilized a diverse set of stakeholders during its planning phase, reflecting the principles of the Quadruple Helix model and establishing a foundation of trust and collaboration. The workshops enabled not only consultation but also meaningful co-creation, with evidence of mutual learning and growing engagement over time. Second, the process of co-planning proved effective in refining participatory proposals into feasible interventions, illustrating how Living Labs can balance citizen creativity with institutional feasibility. Third, the use of a Theory of Change framework provided a structured yet flexible tool for collective reflection. It revealed shared long-term goals, divergent but complementary pathways, and highlighted unintended gaps such as the insufficient inclusion of vulnerable groups. This reflective mechanism enhanced transparency and strategic alignment, underscoring its potential as a replicable evaluation tool for other Living Labs.

Despite these strengths, several areas for improvement emerged. Firstly, the data on which these findings are based are limited, through the case-study approach and reliance on workshops, few interviews, and observations. All communications were not accounted for, such as communications between core members of the SWICE UNIGE team and different stakeholders. Secondly, recruitment of the Living Lab participants could have been diversified beyond existing trust networks to avoid overreliance on already-engaged actors. This could have been combined with a strengthening of communication strategies through a combination of online and offline channels to broaden outreach, especially to underrepresented or marginalized groups. Thirdly, while co-planning benefited from close collaboration with municipal departments, it also revealed a tendency for proposals to be filtered through administrative priorities. Future efforts could make the selection process more transparent and explore mechanisms to safeguard citizen inputs from being sidelined. Finally, long-term sustainability of the Living Lab will require maintaining stakeholder motivation and preventing symbolic participation or participation fatigue through continuous feedback loops, visible short-term results, and recognition of contributions.

Overall, the Jonction Living Lab demonstrates the value of Living Labs as participatory, transdisciplinary platforms for addressing urban climate challenges in legitimate and practically grounded ways. By fostering diverse participation, refining ideas into feasible interventions, and employing Theory of Change as a reflective mechanism, it has established a strong basis for scaling up. Future research and practice should build on these lessons by deepening inclusion, enhancing communication strategies, and linking participatory proposals with long-term institutional agendas.

Appendix:

1. Observation Note-Taking Grid

Inclusion and quality of participation

We have taken deliberate steps to encourage a deep quality of participation in this CAL. How are they working in practice?

1. We want to be able to control for **gender and other forms of inclusion** in this CAL during the analysis - in the room or by table.

Numbers & breakdown of genders

2. We apply the ladder of participation framework, to evaluating the **quality of participation** of all participates in our CAL.
   Quick code: The participant(s) is(are):
   (1) in control / making decisions / facilitating strongly (2) Discussing, debating (3) Being consulted with, having their information gathered (4) Being informed

Event flow	Observation notes
Part 1	
Part 2	
Part 3	

3. Observations on group dynamics
(i) Which gender talks more?
(ii) Is anyone being excluded? Who? Why?
(iii) Which narratives dominate?
(iv) Are there counternarratives or alternative narratives being expressed?

Event flow	Observations
Part 1	
Part 2	
Part 3	

2. Semi-Structured Interview Guide

Context: Follow-up on the two workshops and City meetings

Objective: To understand the institutional challenges, participatory dynamics, and strategies in fostering inclusive participation for UHI adaptation in Jonction.

1. Introduction (Context Setting)

Can you briefly recap the purpose of the two beginning /end-of-year meetings with the city (one in their offices, another here in UNIGE with people also on Zoom)? What were the key objectives/ What did you discuss during this meeting?

Do you feel there is any difference between the online meeting and the real meeting?
Did remote participation (Zoom) change how people engaged or made decisions?

Can you briefly recap the purpose of the two workshops that organised last year at the 3DD space? What were the key objectives/ What did you discuss during this workshop?

2. Institutional Cooperation

Who were the main actors in these meetings? How would you describe their roles (e.g., decision-makers, resistors, facilitators)?

Who do you think was missing from these meetings, and what perspectives or contributions might they have brought?

How does the City's involvement align (or clash) with the original goals of the Living Lab?

What institutional barriers or enablers have you observed in collaborating with the city?

What were the most contentious or debated topics in these meetings? Were there disagreements, and how were they resolved (or not)?

In your view, what actions or initiatives can we realistically pursue in the short term with the City? And what might require a longer-term effort?

3. Participation Dynamics

Which stakeholder groups have been most/least engaged in the co-design process? What systemic barriers explain these patterns?

How did the dynamics differ between those city meetings and the workshops?

Have you observed instances where certain groups (e.g., city officials, academics) dominated decision-making?

Were there moments where certain individuals or groups strongly influenced outcomes? How did that play out?

Were there any unexpected alliances or oppositions between stakeholders?

As I knew that the budget was cut from federal level. Do you think it has a big impact on your overall planning and implementation of LL? --- hinder equitable participation? (e.g., translation services, childcare at events)

During the workshop discussions did you feel that different participants used different terminology, which led to misunderstandings?

Do you actively reach vulnerable groups (e.g., elderly, migrants) who may not attend workshops? What has succeeded/failed?

Did anyone seem excluded or sidelined in the planning step? Did you repeatedly invite existing partner organizations during the preparation period, but did you miss any vulnerable groups?

You used many participartory methods in Jonction Living Lab. Is ethical approval granted by the University of Geneva ethics committee (CUREG2.0)?

4. Outcomes & Reflections

What were the tangible outcomes of these meetings? Were there decisions made, or were they more about discussion?

What roles do you think residents play with local organizations? As consultants, partners, or...

Do you think the entire decision-making control is concentrated in the hands of municipal agencies and universities or residents? Residents are mostly "consultees"? or decisionmaker

Compare the workshops and city meeting, do you think one more productive than others? Why?

Which co-designed UHI solutions have moved to implementation? Were any community proposals rejected due to technical/political constraints?

5. Closing (Self-Critique)

Looking back, what worked well, and what would you do differently in future stakeholder engagements?

If you could redesign the participation process from scratch, what would you change?

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