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Living Labs as Cultural Infrastructures: Performing and Normalising Circular Fashion Practices

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Abstract

The transition to circular models in fashion and textiles requires changes that go beyond technical innovation. The literature recognises that systemic change depends on the transformation of shared meanings around consumption and production, and that spaces for co-design and collaborative learning are crucial to generating this transformation. This article documents how Living Labs operate in this capacity, analysing the Madeback Circular Fashion Festival (May–November 2025), a pilot project of the Fashion & Textile Living Lab at the Politecnico di Milano. The study employs the Living Lab Integrative Process (LLIP) as both a design framework and an analytical lens. Adopting a qualitative and participatory method, the study documents how the three spaces of the LLIP—Problem Space, Solution Space and Implementation Space—simultaneously structured both design innovation and empirical analysis. The results point to three main contributions: (i) Living Labs can function as cultural infrastructures in which performative and narrative dimensions may contribute to the gradual normalisation of alternative practices; (ii) the Quadruple Helix operates as a living process characterised by distributed intentionality and emerging trust; and (iii) transformative learning appears through the co-production of knowledge in embodied and relational practices. The article identifies contextual factors that enabled the project—from its location in a design university to its multi-year funding—and the related constraints on transferability, concluding that Living Labs are promising infrastructures for sustainable transitions when they consciously integrate performative, cultural and relational dimensions.

Keywords: Living Lab; Madeback Circular Fashion Festival; fashion sustainability; Quadruple Helix; transformative learning; cultural infrastructure

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1. Introduction

The fashion and textile industry is recognised as one of the most dynamic and creative sectors of the European economy [1] and is also one of the most challenging in terms of environmental and social sustainability. In fact, it is estimated that the fashion system is responsible for a significant demand for natural resources [2,3], the production of large quantities of waste and scrap [4], and long-term impacts on ecosystems [5], as well as social issues related to labour and the global supply chain [6]. The urgency of rethinking existing models is reflected in the growing focus on extending product life cycles and reducing pressure on natural environments, in line with regulatory strategies such as the EU Strategy for Sustainable and Circular Textiles [7] and the Ecodesign for Sustainable Products Regulation [8], which set the course for circularity and new models of production, distribution and consumption by 2030.

However, the literature highlights that systemic change in the fashion sector involves not just technological or regulatory change but also a profound cultural and social transformation [9,10]. It is therefore essential to develop enabling environments and mechanisms capable of supporting collective learning processes, co-creation between actors, social mediation [11] and the generation of new meanings and skills that may contribute to the normalisation of circular practices [12].

In this scenario, the Quadruple Helix approach (QH)—which integrates the scientific community, industry, institutions and citizens—is gradually establishing itself within the scientific community and in European policies as a reference point for designing innovative ecosystems geared towards sustainability [13,14]. Living Lab models, in particular, are recognised as open and collaborative infrastructures firmly anchored to the ability to activate the QH, capable of facilitating real experimentation and multi-actor learning processes [15]: the literature emphasises their role as catalysts for sustainable transitions [16], where co-design, inclusive governance and social engagement are activated through iterative cycles and action in real-life contexts [17].

In this context, the Madeback Circular Fashion Festival was developed as the first pilot project of the Fashion & Textile Living Lab "Too Cool to Go Wasted", a permanent interdepartmental infrastructure of the Politecnico di Milano, created within the MUSA (Multilayered Urban Sustainability Action) project funded by the National Recovery and Resilience Plan (NRRP). The Living Lab operates as a systemic platform for the collaborative experimentation of new practices [18], the dissemination of knowledge and the transfer of research results to society and industry [19], acting as a space for intermediation between academia, the manufacturing sector and local communities.

The Madeback Festival, which took place from May to November 2025, is a local initiative focused on promoting circularity in the textile sector. It involved various types of stakeholders through activities such as themed galleries, demonstrations of circular practices, practical workshops, swap markets and meetings between brands, designers, artisans and citizens. The project encompassed multiple aspects of textile circularity, including the collection and processing of post-consumer textiles, post-treatment care, and upcycling projects, as well as proper end-of-life treatment.

From an operational point of view, the festival served as an agile testbed [20], acting not only as an event but also as a hub for the integration of processes, actions and relationships between actors, promoting co-design, experimentation with collaborative processes and the materialisation of social learning models. The initiative enabled the identification and enhancement of heterogeneous circular practices already present within the community, promoting their emergence, collective recognition, and aggregation into more structured networks of collaboration and exchange. Furthermore, it has made visible a latent potential for sustainable practices, activating system processes aimed at connecting, amplifying and consolidating knowledge and models of action that often remain scattered or marginal. In this way, Madeback has initiated an attempt to "systematise" circularity in textiles, translating individual or isolated experiences into a shared and integrated operational framework at the local level, serving as a pilot setting for coordinating and testing circular practices.

From a theoretical perspective, this contribution adopts the Living Lab Integrative Process (LLIP) [21,22] as an operational and analytical framework for examining collaborative innovation in complex contexts and domains, such as sustainability in the fashion industry. The LLIP enables the systematic articulation of stages leading from the emergence of innovative practices to their institutionalisation, providing an analytical tool applicable to innovation firmly rooted within the QH framework. The current research documents the application of the LLIP framework in the development and analysis of the Madeback Festival. Madeback operates in all three "spaces" provided by the LLIP framework, which

include Problem Space, Solution Space, and Deployment Space, engaging in multi-level community activities with the participation of citizens, artisans, designers and companies, in distributed co-design of circular practices and public demonstration of scalable solutions.

Although existing literature has extensively conceptualised Living Labs as innovation infrastructures that support experimentation, user-centred design, and collaborative governance [14,23–28] in transitions towards sustainability [13,16,29], there is relatively little research on how they operate as cultural infrastructures that mediate meanings, narratives, and embodied practices [30–32] in specific sectors, such as fashion. In particular, the role of performative and narrative dimensions in normalising circular practices remains underexplored [12,33], especially when Living Labs are embedded in local ecosystems and operate across multiple engagement spaces. In this context, the study aims to examine how a fashion-oriented Living Lab can mobilise cultural, relational and performative mechanisms to support circular transitions through the Madeback Circular Fashion Festival. Specifically, the study investigates: (i) how the LLIP framework structures a Living Lab process, from the initial exploration phase to public demonstration; (ii) how cultural meanings, narratives and embodied practices are enacted and negotiated within this process; and (iii) how Living Labs can be understood and practically configured as cultural infrastructures that contribute to the early normalisation of circular textile practices in a local context.

The article is structured as follows. Section 2 presents the theoretical framework on Living Labs, LLIP and circular transitions in the fashion and textile system. Section 3 outlines the methodological approach and case study design. Section 4 reports the empirical results for the three LLIP spaces, highlighting the dynamics of co-design, social learning, and trust-building. Section 5 summarises the three theoretical contributions that emerged from the empirical analysis and, finally, Section 6 identifies the contextual factors that made the project possible, the constraints on transferability and discusses the implications for future research.

2. Theoretical Framework

2.1. Living Lab: Infrastructure for Innovation and Cultural Mediation

Over the past two decades, Living Labs have fundamentally shifted the paradigms of collaboration among academia, industry, the public sector, and communities and civil society in addressing complex sustainability issues [13,14]. As user-centred design and innovation platforms, Living Labs today are distinguished by their potential to facilitate innovative forms of multi-actor collaboration in the QH framework [28] and act as a "border zone" to produce, prefigure, and translate innovative knowledge in the form of systemic and policy innovations [26]. The European Network of Living Labs (ENoLL) suggests a three-level framework to understand Living Lab dynamics: the macro-level governs strategic vision and ensures systemic alignment, the meso-level implements multi-actor collaborations and coordinates partnerships, and the micro-level prototypes and tests solutions [26,34].

In the field of sustainability, the effectiveness of Living Labs in system transition depends on their ability to integrate various dimensions, including those that cannot be captured by technical innovation alone [35]. The current literature highlights the need for a so-called "cultural turn," whereby Living Labs must act as both technical nurturing agents and performative infrastructures [36]. From this perspective, experimentation enables actors to "enact" their futures within the present in relation to sustainability, suggesting that the materiality of experimental practices may foster the discussion and potential normalisation of new norms and meanings through direct experience [37]. This shift towards the cultural and performative dimension is a constitutive element of Living Labs' ability to generate profound transitions, as it recognises that sustainable change requires

not only technological innovation but also the transformation of collective frameworks of meaning [35,36].

The dimension of transformative learning [38], therefore, becomes fundamental in qualifying Living Labs as arenas of collective reflexivity in which this normalisation of alternative practices can take root. In other words, rather than relying exclusively on instrumental modes of knowledge acquisition, co-creation cycles encourage constant criticism of value systems and socio-cultural practices accepted in research, practice and policy formulation [39,40], and factors that promote success include an open design, multidisciplinary teamwork and reflective processes capable of transforming participants' experience into systemic competencies [41]. In this way, transformative learning can be understood as a key mechanism through which performative and cultural dimensions translate into changes in the practices and capabilities of the actors involved [42].

In this integrated scenario of technical innovation, cultural transformation and collective learning, Living Labs play a crucial intermediary role, coordinating complex networks and mediating between the methodological rigour of research and the active empowerment of stakeholders [21,43]. This ability to transcend organisational boundaries reinforces the role of universities and public institutions in fostering transformation as a means of connecting application and experimentation platforms with citizen participation [13,44]. However, significant challenges remain, particularly concerning the intentional integration of the narrative and cultural dimension [45] necessary to engage a diverse audience and facilitate profound change [46]. It is precisely in response to these challenges that the LLIP framework represents a relevant methodological opportunity, explicitly structuring how innovation, collaboration and learning can be coordinated along an iterative process.

2.2. The LLIP as a Recursive Framework for Collaborative Innovation

LLIP represents a methodological framework developed by Mastelic [21] and further refined by Arias et al. [22] to address complex collaboration processes in innovation settings. From an operational perspective, the LLIP describes the innovation cycle in three related spaces.

The Problem Space includes the stages Empathise, which involves achieving an understanding of the socio-economic environment, and Define, which focuses on identifying barriers, challenges, and opportunities. In the Problem Space, there is collaboration in mapping needs, practices, and shared understanding within the community among the researchers. It may not only act as an environment for diagnosis, but also for building relationships.

The Solution Space comprises Ideate, Prototype, and Test phases, during which collaborative design of interventions, pilot testing in real contexts and evaluation of tested activities take place, respectively. The Solutions Space is also a learning area where solutions and ideas are developed, validated and refined through continuous feedback in a non-linear process, leading to the creation of prototypes and ideas.

The Deployment Space encompasses Implementation (the integration of the system within a real operating context) and Scale-Up (the subsequent expansion and institutionalisation of the system). This space takes the validated prototypes developed at the Solution Space and transforms them into established and embedded practices, which are then integrated into a broader ecosystem.

By its very nature, LLIP functions as a recursive system: the results and insights obtained from the Problem Space inform the Solution Space, where prototypes are developed and refined. The changes made in the Solution Space are then tested in real time within the Deployment Space. Eventually, the feedback loop from the Deployment Space could generate new questions and learnings that return to the Problem Space, starting a new cycle. This recursion is not a flaw in the planning mechanism, but an intrinsic operational feature of a generative learning system. By formally structuring these feedback cycles

across the Problem, Solution, and Deployment spaces, LLIP provides a systematic approach to navigating the uncertainty and complexity inherent in socio-technical transitions to sustainability [21,22,39]. On this theoretical basis, the LLIP approach is consistent with the principles of cultural performance and transformative learning, as discussed above. Its recursive form allows for the phase of collective experimentation and reflection that is fundamental to the learning process in sustainable transitions.

2.3. Circular Transition in the Fashion and Textile System

The EU fashion and textile industry is currently undergoing a significant transformation driven by the crisis of the linear model [47], regulatory pressures [48] and civil society's growing focus on environmental and social sustainability [49]. The sector is one of the primary contributors to adverse environmental impacts globally, encompassing waste production, resource consumption and pollution [50–53]. In response, the European Strategy for Sustainable and Circular Textiles and the Ecodesign for Sustainable Products Regulation, within the broader framework of the European Green Deal [54], position fashion and textiles as priority domains for accelerating circularity through durability, repairability, recycling and extended producer responsibility.

The question among scholars and policymakers relates to the need for systemic, multi-level change that extends beyond using clean technology as the sole strategy for change. Current debates emphasise shorter supply chains, innovative business models and the strengthening of public–private partnerships [55], alongside strategies such as aftercare, repair, upcycling, sharing and the digitisation of life-cycle information, which have been identified as key enablers of sustainable fashion [56–58]. At the same time, recent regulatory measures emphasise the importance of digitalisation and traceability (of which the digital product passport is a vehicle [59]), as levers for competitiveness and for mitigating the effects of linear business models. Yet, while these technological interventions are critical enablers, the transition to a circular economy in fashion requires equally urgent attention to epistemic and cultural dimensions.

Within such a framework, adopting the circular economy approach implies a comprehensive re-evaluation of practices, roles, and associated meanings in consumption, production, and design [11,60]. In the fashion system, the circular transition is not just a matter of resource efficiency, but implies a radical reconfiguration of perceived value: it requires decoupling the concept of "new" from that of "value" and transforming the user from a passive consumer to an active and competent citizen [3,61]. Contemporary literature clearly identifies that the main barrier to circularity is not technological but epistemic: the loss of material literacy—i.e., the ability to read, understand, and consciously intervene in materials and production processes—and the structural disconnection from production processes make it difficult for individuals to imagine and practise alternatives to the linear model [61,62]. This epistemic gap is at the root of the persistent difficulty in moving from sporadic "green" behaviours to structurally integrated circular practices.

Consequently, actions to normalise circularity cannot be imposed exclusively top-down through policy and technology, but must emerge from situated participation processes that make circular practices culturally desirable and socially legitimate [12]. Normalisation actions are interpreted not only as technical or organisational interventions, but as social processes aimed at creating new communities of practice, collective prototyping and the dissemination of established practices through experiential and engagement-based learning pathways [39,63,64].

To facilitate this social and cultural transformation, universities, Living Labs, innovation hubs and territorial networks are promoted as places where ecosystems of knowledge, social capital and collective transformation capabilities are developed [44]. In this regard,

the Living Lab infrastructure helps address the systemic specifics of fashion by acting as a cultural intermediary. These infrastructure systems are not only limited to transferring technological knowledge; instead, they enable new forms of collective practices for care, maintenance, and transformation [12]. These collaborative platforms and public gatherings become strategic tools for transforming abstract policy norms into tangible practices [18], simultaneously enabling participants to negotiate new identities and competencies through their situated participation in communities of practice [65]. In this way, the Living Lab facilitates the cognitive and cultural transition necessary to evolve from the sporadic adoption of "green" behaviours to the structural integration of circularity [66] as a new social norm—operating on that dimension of material literacy and awareness that technology and regulation alone cannot generate.

3. Materials and Methods

The research adopts a qualitative and participatory perspective, based on two complementary methodological approaches: action research and Research through Design (RtD) [67,68]. These methodologies were selected for their suitability in investigating complex and situated phenomena within sustainable transition contexts, where the goal is not only neutral observation but the generation of knowledge through direct intervention and transformation of the context [69,70].

The study considers the Madeback Circular Fashion Festival not as an isolated event, but as a "dense episode" of experimentation within a broader research infrastructure [71]. To analyse this process, the LLIP methodological framework (see Section 2.2) was applied both as an ex ante project structure and as an ex post analytical grid.

3.1. Research Context and Case Selection

The Madeback Circular Fashion Festival is situated within the Fashion & Textile Living Lab "Too Cool to Go Wasted", a permanent interdepartmental infrastructure of the Politecnico di Milano based at the Bovisa Design Campus. The festival was coordinated and hosted by the Department of Design and developed as part of the MUSA innovation ecosystem funded by the NRRP.

The Madeback pilot project was selected as a representative case study [72] for its ability to condense, within a defined time frame (May–November 2025) and in a limited physical space, a multiplicity of interconnected actions related to the circular supply chain. Madeback followed an incremental process: from the systematic collection and cataloguing of used clothing (over 500 items) to labelling and thematic archiving in the Community Wardrobe, to three preparatory workshops involving designers, artisans and fashion collectives engaged in upcycling and redesign processes. The festival itself condensed this accumulation of practices and knowledge into three highly intensive days, during which experiences were activated involving the participation of 14 circular fashion designers/artisans, five brands, around 90 workshop participants and 160 talk participants, with over 300 garments regenerated through upcycling or repair, documented in their transformative journey and put back into circulation. The initiative therefore simultaneously integrated three interconnected streams of activity: (i) post-consumer collection and management (through the Community Wardrobe); (ii) transformation and regeneration (through upcycling, repair and co-design workshops); (iii) redistribution and exchange not only of material outputs (through swap activities) but also of knowledge, skills and practices (through thematic exhibitions, live demonstrations and talks).

This systemic configuration has enabled the observation of interactions between various actors, including academia, local brands, artisans, citizens, and students, as the QH approach is deployed in a social experimentation environment.

3.2. Research Design and Operationalisation of the LLIP

The research followed a longitudinal design divided into three macro-phases, corresponding to the spaces of the LLIP framework. Operationalisation transformed theoretical concepts into specific research activities:

Phase 1: Exploration and Activation (Problem Space—May/June). Corresponding to the Empathise and Define phases. This phase involved both diagnostic and relational objectives. First, the Community Wardrobe served as a cultural probe, assisting in the qualitative understanding of the drivers of discarding and the inhibitors of product life through the use of second-hand clothing. At the same time, on a relational level, the Define activities took the form of systematic mapping and engagement with local actors (designers, artisans, third sector). This early mobilisation was fundamental in transforming a network of potential contacts into an active project community, co-defining each stakeholder's role according to the QH logic.

Phase 2: Co-design and Prototyping (Solution Space—July/September). Corresponding to the Ideate, Prototype and Test phases. In this space, the Living Lab functioned as an incubator of practices. Three intensive preparatory workshops were organised with selected stakeholders (designers, artisans, students, and citizens) to co-design not only the material outputs (regenerated garments) but also the engagement formats (narratives and installations). Here, the research adopted co-design methods to observe how negotiation between different skills—for example, between academic knowledge of design and tacit knowledge of craftsmanship—influenced the quality and replicability of the proposed solutions.

Phase 3: Demonstration and Consolidation (Deployment space—October/November). During the Implement and Scale-up phases, and in line with the festival and subsequent periods, the focus shifts beyond protected experimentation to validation in actual settings. The festival serves as a living testbed to evaluate the level of acceptance of circular practices, specifically exchange, repair, and upcycling, among a broader, non-expert public. At the same time, the post-event period was monitored to detect signs of scale-up and autonomy of the activated networks.

Furthermore, the implementation of the LLIP continued to extend beyond the logistical arrangement to conceptualise and design the event's performative aspect (narratives and spatial dramaturgy). This event was recorded, not as a secondary issue, but as a formative element that has the potential to drive the cultural transition as conceptualised in the theoretical framework.

The LLIP was implemented with particular attention to the configuration of participants' roles and their involvement across the project's different phases. Participants were recruited through targeted and snowball sampling strategies, in line with the Living Lab's existing networks and QH's multi-stakeholder logic. The selection criteria prioritised diversity in the types and roles of actors rather than a predetermined sample size. Specifically:

Designers and artisans (n = 14) were selected based on their demonstrated commitment to circular practices in fashion; willingness to co-design and publicly demonstrate practices, and geographical proximity to the Living Lab (Milan area) to enable regular participation during the six-month duration of the project.

Brand and industry representatives (n = 5) were identified through the industrial partnerships of the NRRP MUSA ecosystem and selected based on their strategic interest in circular business models and their ability to engage in extended collaboration (workshops, co-curation, conferences).

Workshop participants (n~90) were recruited through calls for participation distributed via the Living Lab's communication channels. Participation was voluntary and free of charge, and, as with the visitors, involved both the campus community and local citizens in equal measure.

Finally, for festival visitors and talk participants (n~160 for talks, over 300 for the swap activities, no data for the gallery's visitors), no formal selection was made, as their participation was voluntary and episodic.

This layered but, at the same time, flexible approach to participant selection reflects a commitment to inclusively engaging multiple actors, while recognising that the intensity and depth of engagement varied significantly depending on the type of participant. To clarify the roles of different actors across the project's stages, Table 1 provides an overview of the participant groups, their roles, approximate numbers, phases and intensity of engagement.

Table 1. Participant roles and phases of involvement across the Madeback Circular Fashion Festival.

Participant Group	Role in the Project	Approx. Number	Phases of Involvement	Intensity of Engagement
Designers and artisans	Co-design and facilitation of workshops, co-curation of gallery, live demonstrations	14	Pre-festival (coordination meetings, workshops, gallery), Festival (workshops, gallery, demos), Post-festival (workshops)	Continuous, multi-phase, core stakeholders
Brand and industry representatives	Strategic input, talks, showcasing circular practices	5	Pre-festival (coordination meetings), Festival (talks, public presentations)	Short-term, focused on specific activities
Workshop participants	Testing circular practices, co-learning, feedback, material circulation	~90	Pre-festival (community wardrobe, workshops), Festival (swap market, workshops)	Short-term, focused on specific activities
Visitors	Public engagement, experiential learning, material circulation	300+ (swap), ~160 (talks), no data available (gallery)	Pre-festival (community wardrobe), Festival (swap market, talks, gallery, demo), Post-festival (swap)	Episodic, low commitment
Lab team	Project coordination, facilitation, documentation	4–8	All phases	Continuous, infrastructural role

3.3. Data Collection and Analysis

Given the procedural nature of the Living Lab, a multimodal data collection strategy (triangulation) was adopted, combining ethnographic, material and documentary sources.

Direct participatory observation: The research group participated in and systematically documented all phases (collection and cataloguing of the Community Wardrobe, organisation of workshops, curation and set-up of the Gallery and live demonstrations, continuation of the Swap Market after the event). Field notes, evolutionary maps of the spaces, documentary photographs, and audio-video recordings of significant exchanges were produced and analysed [73].

Analysis of materials and artefacts: All material evidence produced was collected (workshop outputs, posters and graphics from thematic galleries, video interviews with designers and artisans, photographic reports of the transformation processes, and digital campaigns). This analysis traced engagement patterns, the quality of regenerated products, the diversity of co-design practices, and potential replicability [74].

Qualitative monitoring of feedback: Opinions, suggestions, ideas, and proposals were collected informally through conversations by the research team during briefings and debriefings, direct feedback from designers and artisans, spontaneous comments from participants, and posts on digital platforms. The nature of field research makes this light ethnographic method effective for reconstructing the tacit and social dimensions of learning during the festival [75].

Document analysis: The examination of documents covered an analysis of briefings, press notices, guidelines for curators, protocols for traceability and labelling, and templates used to write workshop documentation. These documents ensured that there was cross-referencing of observed data with the strategy's logic to identify convergences and divergences between planning and actual implementation.

The analysis was conducted collaboratively by the research team through an iterative, reflective process [76] aligned with action research and RtD methodologies. The analytical process took place in three interconnected phases: (i) Descriptive coding: all the material collected was organised chronologically and thematically according to the three LLIP spaces. The initial codes emerged inductively from the data throughout the project period. (ii) Interpretative coding: through iterative engagement with the data corpus, empirical themes such as patterns, dynamics and tensions relating to cultural-relational dimensions emerged. Particular attention was paid to the interpretation of themes such as widespread intentionality in QH, trust-building processes, participant engagement and the performative aspects of circular narratives. (iii) Theoretical integration: the empirical themes were aligned with the theoretical constructs of Living Labs as cultural infrastructures, the dynamics of QH, and transformative learning ecosystems. A summary of the links between the theoretical constructs and the empirical foundations is presented in Section 5.

Throughout this process, regular meetings held during the project period and post-festival sessions served for collective sense-making, and different interpretations and understandings were discussed and reconciled through dialogue and reference to empirical evidence.

3.4. Researcher Positioning and Reflexivity

The project adopts an "insider researcher–designer" perspective, combining active design processes with the facilitation of collaboration and observation, in line with RtD principles [68,70]. In this epistemological framework, design practice is viewed as a legitimate mode of knowledge production, in which interpretative outcomes emerge from relationships among action, artefact manipulation and embodied participation [69,77].

Operationally, by taking on multiple roles, the team co-designed the festival's structure, facilitated workshops, mediated among various stakeholders, and curated across the festival's areas. This hybrid position allowed privileged access to tacit knowledge, relational dynamics, and emerging tensions that would have been difficult for external observers to see [78], an aspect in line with discussions on the roles of insiders and members in field research [79].

Such deep involvement, however, carries risks, in particular the possibility of self-referential biases, a selective reading of project dynamics, or an unproblematic overlap between project intentions and observed results. However, the literature on reflexivity in qualitative research and action research highlights that being proximal to the field does not, per se, constitute a methodological problem, but instead requires the adoption of reflexive practices to ensure greater interpretative rigour [80,81].

To mitigate these problems and to guarantee greater interpretative rigour, structured reflexive practices were adopted throughout the entire process: periodic briefings during the planning phase, individual and collective field diaries, and post-festival debriefing sessions with team members and some stakeholders. These measures made it possible to question initial assumptions, highlight discrepancies between points of view (e.g., the risk of "academisation" noted by some artisans and designers), recognise the performative effects of the researchers' presence (such as the awareness of "being observed" by some participants) and review interpretations formulated under time constraints (project deadlines sometimes accelerated negotiation and decision-making processes). In this sense, subjectivity was treated not as a bias to be eliminated, but as an epistemological resource for accessing the relational, negotiable and affective dimensions of co-creation, while recognising that internal involvement inevitably influenced both the project's development and the interpretation of its outcomes.

The entire research methodology is summarised in Figure 1.

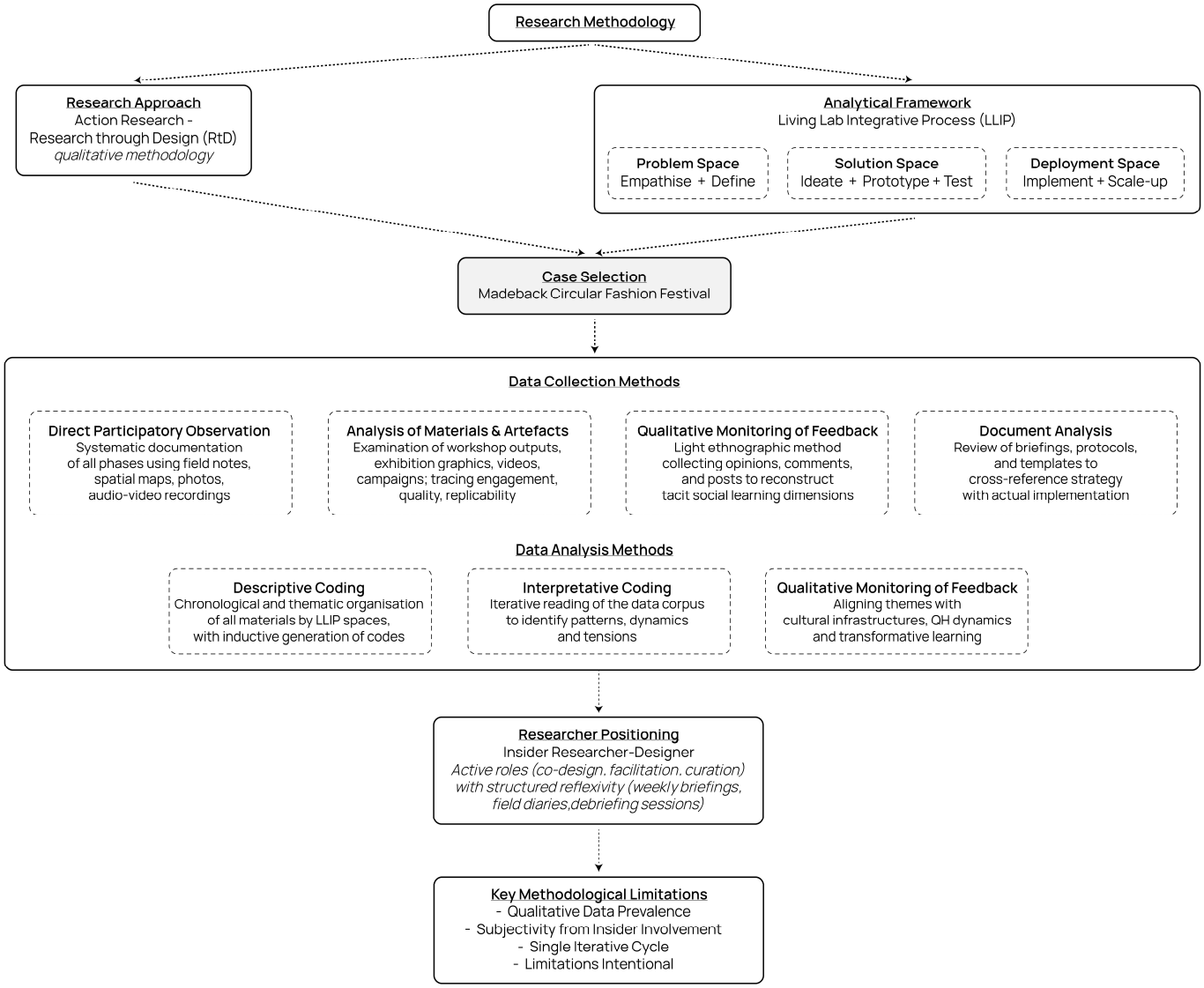

Figure 1. The diagram hierarchically presents the Madeback Research Methodology Framework, integrating the research approach and the LLIP as analytical framework, together with data collection and data analysis methods, researcher positioning, and methodological limitations.

3.5. Methodological Limitations

The research also points out inherent limitations: (i) imbalance in the type of data, with an abundance of qualitative information rather than quantitative; (ii) subjective interpretation based on direct involvement in research, which, despite structured reflexivity practices (see Section 3.4), may have influenced both the design of activities and the interpretation of outcomes; and (iii) the six-month period limited the observation to one complete LLIP cycle, preventing the assessment of long-term changes, network durability, or lasting changes in meaning-making patterns beyond early indicators of consolidation [78]. These aspects, however, align with the approach adopted in Living Labs, prioritising, the development of process understanding and innovative paths over generalisable statistics [16,19].

4. Results

This section presents the results of applying the LLIP to the Madeback Circular Fashion Festival, following the trajectory of the three methodological spaces: Problem Space, Solution Space and Deployment Space. The analysis shows that, over the six-month project span, feedback generated in a given phase drove the next phase, leading to modifications in activity

design and stakeholder networks. The following three subsections will provide a detailed explanation of the phases that occurred from May to November 2025: an exploratory and constitutive phase, a distributed co-design phase, and a public materialisation phase.

While the LLIP framework and Madeback Festival design were guided by explicit assumptions about the potential of Living Labs to promote cultural normalisation and transformative learning, the following subsections focus on empirical evidence gathered in the three LLIP spaces. The interpretative and theoretical implications of these observations are further elaborated in Section 5.

4.1. Problem Space: Emergence of Meanings and Network Activation

Exploration and Activation Phase (May–June).

The research began with the assumption that circularity in fashion is not purely a technical issue but rather a question of culture, habits, meanings, and relationships among heterogeneous actors [9,66]. With this in mind, the initial phase involved a double mapping: an ethnographic mapping of the material context and a relational mapping of stakeholders.

Empathise: Listening and initial activation of the community. The Community Wardrobe is the primary tool used in this phase. Through two collection campaigns on the university campus (May-June), open to both the campus community and the neighbourhood, over 500 items of second-hand clothing were collected. Unlike a traditional collection, the initiative positioned the process as an opportunity to listen to and engage the community [14], as the garments themselves embodied stories of consumption and disposal behaviours [12]. This qualitative documentation process provided key insights into both the physical evidence of discarded garments and social perceptions of reuse, thereby influencing certain aspects of the festival's curation.

Define: Structured cataloguing and co-definition. At the same time, a multidimensional cataloguing process was applied to all collected garments, including classification by type and size, analysis of material composition, assessment of physical condition (good condition, minor damage, severe damage), and reparability assessment. Building on this cataloguing work, the team developed a system for managing material flows, including traceability protocols and a multidimensional labelling system reporting each garment's history, condition, repairability, and recommended services, as well as a "real-time visible repair" arrangement during the Swap Market. Together, these tools generated an empirical "discard patterns" map providing multidimensional information on typical patterns of deterioration, perceived speed of obsolescence, and the dissonance between residual use value and the psychological value assigned to objects by their original owners [82]. The data subsequently influenced the design of workshops and strategies for a "re-engagement" with clothing items.

In parallel, the team conducted a systematic research process, selection, and contact with a large number of local actors, including independent designers, artisans, service providers focused on circularity, and local organisations. Based on this extensive mapping and through bilateral meetings, 14 actors with different roles were selected, negotiating with each one their specific contribution: who would conduct practical workshops, who would carry out performative demonstrations, who would curate exhibition galleries. This selection and co-definition of roles made the QH logic operational from the earliest stages, in the sense that academia, the creative industry, institutions and civil society were involved as active contributors to the design rather than as external observers.

4.2. Solution Space: Distributed Co-Design and Validation

Co-design and Prototyping Phase (July–September).

Using insights from the Problem Space, the team operationalised the Solution Space along two parallel lines: on the one hand, the prototyping of circular practices through preliminary workshops and the co-design of the exhibition structure; on the other, the validation of the practices themselves with a view to systematising them during the festival.

Ideate & Prototype: Preliminary workshops. The first strand involved the creation of three workshops dedicated to different practices of textile regeneration and upcycling [83]. The first, hosted at an urban experimentation space sponsored by the municipal administration, was led by a professional specialising in advanced upcycling and consisted of intensive sessions focused on cutting, recomposition and textile transformation techniques. A second workshop, held at a shared local tailor's shop, was led by a creative collective and focused on deconstruction, reassembly and radical customisation of existing garments. A third workshop, spanning three meetings at the Living Lab and the Politecnico di Milano's laboratory spaces, was dedicated to the practice of upcycling for the creation of unique pieces. Starting with pre-selected materials, participants had the opportunity to supplement the pool of fabrics with garments and materials already "in use" from their personal experience. Participants collaborated with workshop leaders to define processes for combining and transforming heterogeneous materials, aiming to create unique artefacts that integrated the materials emerging from the research with the personal narratives incorporated into participants' garments [84]. Approximately 70 garments created during these preliminary workshops were reintroduced into the subsequent material flow, establishing a circular continuity between the preliminary experimentation and the public event.

Co-design of the exhibition. The exhibition space and the Gallery's narrative and curatorial infrastructure were designed jointly. With the collaboration of the ten participating curators-exhibitors, the areas for a narrative exhibition axis were defined and consolidated: Reduce, Repair, Upcycle and End of Life. An iterative process also characterised this phase: meetings were organised with the respective curators to refine their specific vision, collective discussions were held on narrative coherence, and different spatial configurations were tested. This ensured that the structure of the exhibition was not only coherent from a curatorial point of view but also validated by the subjects who would interact with it.

To document this activity, video interviews were conducted in the studio of every exhibitor, during which artisans and designers discussed their methods and work philosophies [85]. This video archive added a parallel narrative layer to the physical experience of the festival, allowing visitors to engage with aspects of the protagonists' processes and motivations that would otherwise have remained invisible.

Test: Pre-deployment evaluation and validation. The testing phase involved three interlocked processes. Firstly, the system of multidimensional cataloguing and labelling was tested by selecting the content for the preliminary workshops. The rationale for this phase was to assess the functional usability and intuitiveness of the system prior to its large-scale use. Secondly, the research team conducted an assessment of each workshop round. The opinions of the participants were collected, while the quality of the learning processes was ascertained through observation, as indicated by the photographs taken during the process, as well as critical commentary. Based on these iterative insights, the design of subsequent workshops was modified incrementally. Thirdly, the approximately 70 garments created during the workshops were analysed and circularised. The transformation quality assessment, in relation to both technical and aesthetic criteria, was conducted through the addition of the garments to the multidimensional cataloguing of the project and their subsequent return to the material circuit of the Swap Market.

This process functioned as a triple validation test, indicating the effectiveness of the engagement methodologies, the practical feasibility of the transformations, and the material and narrative continuity between the preliminary phase and the deployment phase.

4.3. Deployment Space: Real-World Demonstration and Legacy

Demonstration and Consolidation Phase (October–November).

During the three days of the festival (15–17 October), all the components co-designed in the Solution Space were activated simultaneously in a real operating environment, allowing the research team to observe how the community actually adopted the proposed practices. The spatial configuration was divided between two primary locations on campus: the Fashion & Textile Living Lab (which hosted the Swap Market, four half-day workshops, three performance demonstration areas and discussion sessions on the themes of circularity and sustainability in fashion) and another building on campus traditionally used for educational purposes (which hosted the exhibition Gallery divided into four thematic areas). The distribution adopted aims to facilitate interactions between exhibition rooms and working areas.

Implement: Public demonstration. By serving as the primary connection between research and participation, the workshop system consisted of four workshops, each conducted by professionals in different specialisations. The circular practices also varied from workshop to workshop. These include dry felting from textile residues, upcycled screen printing, narrative embroidery as a symbolic component, and knit-stitch writing as a material writing practice. The workshops involved over 90 participants, meeting specific educational objectives while reaching a broad, diverse audience.

The three performance demonstration stations served as the centrepiece of the attraction. Visitors were able to observe in real time some material transformation techniques, including waste woven into new fabrics, textile fibres transformed into materials for new applications through the frontage technique, and natural fibres processed using the nuno felting technique.

The Swap Market was both a meeting place and a community practice. The approximately 300 transformed garments—including the 70 produced during the preliminary workshops—were made available for exchange. This exchange was not driven by commercial reasons, but it was rather a form of community practice of sharing enabled by narrative feedback. Moreover, a visible mending station provided express repair services, turning the instant of repair into an observed activity [86].

Finally, the Madeback Talks, with over 160 people in attendance, constituted the discursive and strategic level of the event. Experts in traceability, innovation and sustainability engaged in public dialogue with the research team, situating local practices within broader narratives.

In terms of empirical data collection, observations were conducted in a systematic and non-intrusive manner [39], and the recorded flows and emergent opportunities included, for instance, increasing interest in professional repair services [86] and repeated visits by some participants across different activities

Scale-up: Post-event consolidation. After the festival, continuity mechanisms were put in place to encourage the first signs of transition from a pilot event to an ongoing practice. The Swap Market, hosted and managed by the Living Lab team, continued to operate regularly at the Living Lab on a bi-weekly basis. Several community members returned after the festival, bringing additional clothing items to enrich the Community Wardrobe, with the explicit intention of keeping their clothes in circulation and making them available for future workshops. This ongoing and spontaneous commitment suggests the first signs of behavioural change and a partial scale-up, with the practices initiated during the festival beginning to stabilise in participants' daily routines, even though institutional responsibility for the infrastructure remains with the university.

At the same time, the partnership between the Living Lab and a pair consisting of an international outdoor brand and a specialised designer was formalised in an agreement for the joint development of a third cycle of workshops. This represents a concrete transition

from the intermediation of theoretical innovation to the operationalisation of alternative value chains, which sees the Living Lab as a hub of distributed innovation capable of scaling beyond its initial experimental phase [87]. The practices tested (co-design, performative storytelling) have been integrated into the Living Lab's operational cycles, and research is developing documentation to test their territorial replicability [88].

In summary, the Deployment phase has highlighted the iterative and adaptive nature of the Madeback process: feedback from the initial workshops influenced planning for subsequent workshops; observations of audience reaction led to adaptations in talks and setups; and post-event analysis has already begun to inform the co-design of future activities. In addition to the usual parameters of participation and material production, the festival seems to have generated some initial indications of systemic effects: on the one hand, a tentative consolidation of networks of trust between the university Living Lab, industry and creative professionals, as suggested by post-event partnerships; on the other, the first signs that reuse, repair and upcycling practices were beginning to be adopted as socially legitimate ways of relating to clothing.

Figure 2 illustrates the Madeback project timeline, showing the activities, outputs, and participant engagement in the three LLIP spaces.

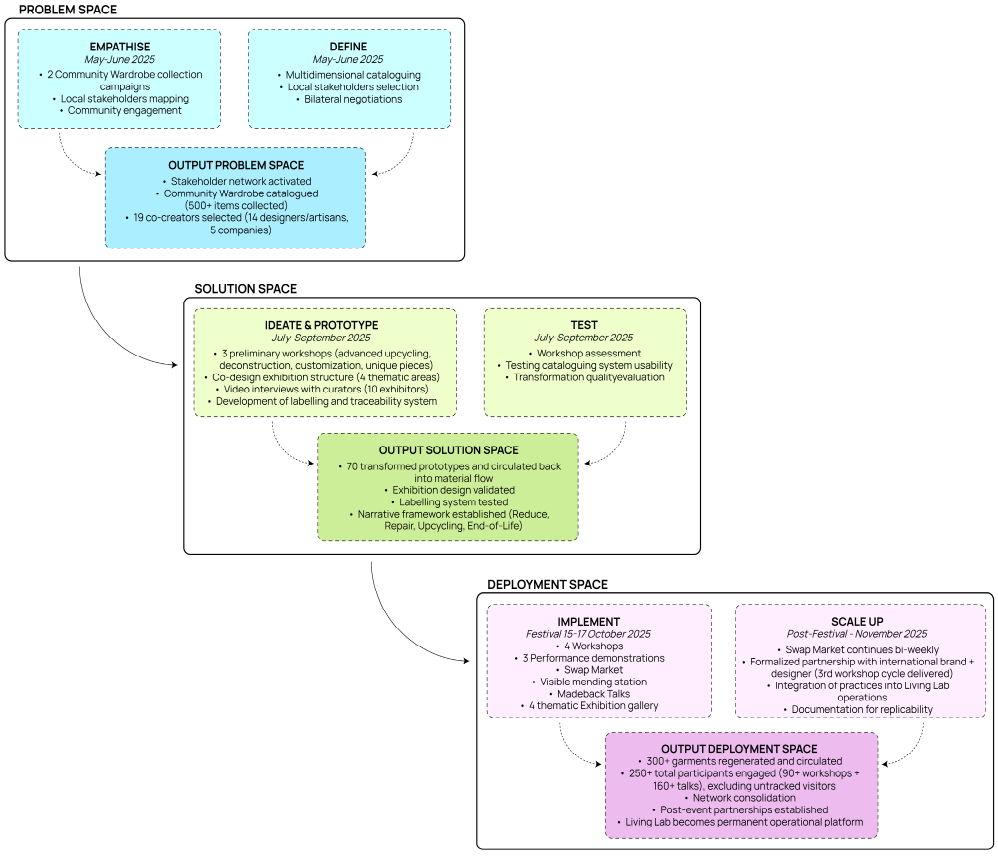

Figure 2. The flow chart illustrates the six-month project structured according to the LLIP. The Problem Space (May–June) documents the creation of the community through the collection of the Community Wardrobe (over 500 garments) and the activation of stakeholders (14 designers and 5 companies). The Solution Space (July–September) presents the ideation and prototyping through three preliminary workshops (approximately 70 garments created) and the co-design of the exhibition with ten co-curators. The Deployment Space (October–November) encompasses the three-day festival (15–17 October) featuring four workshops (with over 90 participants), performance demonstrations, swap market (300+ regenerated garments), and talks (with over 160 participants), followed by post-festival scale-up activities and network consolidation.

5. Discussion

From an analysis of the LLIP implementation within the Madeback Circular Fashion Festival, a set of preliminary theoretical implications emerges that may refine conceptualisations of Living Labs as catalyst systems for supporting sustainability transitions. Before discussing these contributions in depth, Table 2 provides a synthetic overview of how key theoretical concepts are grounded in empirical indicators and observational data, clarifying which elements of the argument rest directly on observations and which constitute interpretive extrapolations.

Table 2. Linking Theoretical Concepts to Empirical Indicators.

Theoretical Concept	Empirical Indicator	Primary Data Sources	Example of Observation
Normalisation of circular practices	Continuation of activities post-event; repeated participation; gradual consolidation of networks	Field notes; participation logs; post-event monitoring	Swap Market maintained bi-weekly after the festival; return of participants over multiple editions; continued use of the Community Wardrobe as a shared resource
Widespread intentionality (QH)	Hybrid role negotiation; cross-sector knowledge co-production; simultaneous contributions during co-design	Workshop debriefs; coordination meeting notes; video documentation	Academic, artisan, and citizen knowledge hybridised during preparatory workshops; designers and artisans demonstrating techniques while participants contributed stories and preferences around garments
Trust as emergent outcome	Evolution of collaborations; formalisation of a new partnership; increasing willingness to share responsibility in co-designed activities	Post-event follow-up; email exchanges; debriefing sessions; workshop debriefs	Progressive co-definition of roles between designers, artisans, brand representatives and the Living Lab team during preparatory meetings; post-event agreement for a third cycle of workshops co-designed by the Living Lab, an international outdoor brand and a specialised designer
Transformative learning	Changes in how participants evaluate garments, time, care, and value	Participant feedback; workshop observations; spontaneous comments	Participants reconsidering garments initially perceived as "unusable" after minor repair or upcycling; increased attention to material quality and repairability during evaluation moments
Performative dimension	Narrative staging; material engagement; spatial dramaturgy; visibility of practices	Video documentation; spatial curation records; photographic reports	Thematic galleries (Reduce, Repair, Upcycling, End-of-Life); presence of a visible mending station during the festival; garments displayed with narrative labels and documented transformation paths
Material literacy	Hands-on manipulation of garments; tactile engagement; recognition of wear and repair patterns	Workshop field notes; artefact analysis; Community Wardrobe cataloguing	Participants identifying damage types and repair options; reading labels and material composition; using catalogue information and direct handling to decide how to transform or reinsert garments into circulation

The results emerging from this research articulate three interdependent dimensions: (1) Living Labs can be interpreted as cultural infrastructures in which material and narrative performances may contribute to the normalisation of alternative practices through enactment; (2) the QH model is explored not as a static governance structure, but as a living process characterised by widespread intentionality, continuous negotiation and trust that tends to emerge throughout the process; (3) transformative learning appears to emerge from the co-production of meanings through embodied, relational and situated practices, as opposed to transmitted or received knowledge relating to purely technical systems or processes of performance and capability development.

Compared with much of the Living Lab literature, which has predominantly focused on technical prototyping, co-design methodologies and stakeholder engagement as primary outcomes [14,23–28], these three dimensions foreground performative and narrative mechanisms, the dynamics of trust within the QH and transformative learning as equally central to how Living Labs can support sustainability transitions.

Moreover, the three contributions are not isolated but intertwined in a specific generative logic: the performative-cultural dimension of the Living Lab—the public expression of the circular alternatives—creates conditions that enable the QH as a living process of

negotiation and co-creation. At the same time, this relational and performative aspect also supports the embodied transformation learning experience, through which some actors not only gain technical competence but also begin to change their meaning frameworks regarding the concepts of value, consumption, and material accountability. It is in this context that the Living Lab is viewed as a systemic tool, where performance and learning are in a mutually reinforcing relationship that can contribute to a cognitive-cultural shift to make material circularity a social norm.

Although Section 4 identified the operational implementation within the three phases of LLIP, this discussion focuses on interpreting those empirical patterns within the theoretical contexts of performativity, QH dynamics and transformative learning, exploring how these theoretical aspects operate and intersect.

5.1. From Problem-Solving to Culture-Making: Living Labs as Cultural Infrastructures

The existing literature on Living Labs frequently emphasises their role as venues for user-centred innovation and socio-technical experimentation in real-world settings, particularly in the fields of smart energy, urban mobility, and resource management [26,89,90]. In the traditional paradigm of technological innovation, innovation is conceived primarily as the provision of technical solutions to well-defined problems [91], with stakeholder involvement limited to testing and functional refinement. However, this techno-centric approach is insufficient when dealing with socio-technical transitions, which require not only new technologies but also the transformation of meanings, practices and collective imaginaries [92]. Living Labs, and in particular sustainability-oriented ones, have been proposed precisely to fill this gap, offering spaces for real experimentation based on co-creation, collective learning, and the production of new cultures [16,39].

Circularity in fashion falls within these contexts of socio-technical transformations. The shift from linear consumption models to circular practices requires not only the implementation of technologies for the more careful use of resources, their reuse, or recycling, but also, above all, a cultural reorientation towards garment care, repair, reuse, and value retention [93]. As Sahakian et al. [94] argue in their study on citizen action labs and energy transitions, sustainability is not a static goal or a normative definition but a concept that is "performed" in temporal (situated in a particular time), local (situated in a particular spatial context) and political (expression of particular values and meanings) dimensions. Their performative perspective reveals how meanings are constituted through ongoing practices rather than transmitted as fixed information.

Madeback can be interpreted as a cultural infrastructure, rather than a problem-solving tool. Its design, in terms of the spatialisation and thematisation of the proposed activities, focused on the narrative dimension: on the one hand, the four thematic areas of the gallery (Reduce, Repair, Recycle, End of Life) functioned more as dramaturgical environments in which circularity was represented and made tangible than as mere information stations; on the other hand, video interviews with designers and artisans, the selection and curation of transformed garments, and live demonstrations constructed a narrative architecture that made circular practices not only understandable but, for many visitors, culturally desirable. This approach aligns with Stacey et al. [95] on "dramaturgies of change", which positions staging, mediation and performance as tools for political—and therefore cultural—transformation rather than communicative accessories.

Central to this cultural infrastructure was also the materiality of the Community Wardrobe—over 500 donated garments that served as an epistemic archive. In this case, the used garments were understood not as mere passive elements, objects or resources for exchange or transformation, but as active mediators that brought stories, meanings and traces of previous lives. In the context of sustainability studies, the performative perspective

has highlighted the role that objects play in transition processes: not only as tools, but as active elements that, through their mobilisation in everyday practices, contribute to building and sustaining new modes of sustainable existence [96–98]. Objects that are involved, manipulated, and made meaningful in everyday actions can be considered "sustainability objects," i.e., objects that claim the ability to promote more sustainable ways of life [98]. Consequently, in the context of interventions such as Madeback, it is precisely through the performative mobilisation of these sustainable objects—for example, transformed garments, repair tools, recycled materials—that the transition towards sustainability begins to take concrete shape in everyday life, and the "objects" themselves can serve as pedagogical agents. Participants were involved in practical activities, such as working with fabrics, identifying wear patterns and imagining the transformation potential of garments. These activities appeared to generate tacit knowledge that cannot be obtained through abstract data alone. This hands-on engagement served as the basis for the transformative learning experiences described in Section 5.3.

From a theoretical perspective, this work proposes an extension of the LLIP approach by incorporating a performative-cultural dimension, which is particularly relevant for socio-technical transitions in sectors such as fashion, where the symbolic dimension holds significant importance [99,100]. As discussed above, this dimension attributes great centrality to narration, the dramaturgy of practices and the "mobilisation of objects" as drivers of new meanings and agents of transformation [97,98]. In the context of LLIP, the performative-cultural dimension can be grafted onto all stages of the process. Firstly, in the Problem Space, the process of constructing "sense-making" and the social desirability of transformation towards sustainability occurs through the recognition and modelling of cultural values, shared imaginaries and symbolic barriers that structure the perception of sustainable and circular practices [101,102]. Secondly, in the Solution Space, co-creation processes are not only aimed at prototyping products or services, but also, to a large extent, at producing narratives, rituals and symbolic representations that help reinforce the perceived relevance and attractiveness of interventions within the community [103]. Finally, in the Deployment Space, the effectiveness and scalability of the proposed solutions depend, at least in part, on their ability to take root in both imagination and everyday practices, through a process of consolidating solutions into new norms, customs and collective references [104].

Adopting this perspective implies that the transition is achieved not only through the functional adoption of new solutions but also, and above all, through the continuous production and negotiation of meaning. In this context, the performative-cultural dimension can act as a critical and operational key to supporting the consolidation of innovation, shaping new social behaviours and, in some cases, becoming integrated into the identity of a community [95]. From an empirical point of view, the first signs of this normalisation process became visible in the continuation of activities after the festival. In the weeks following the event, the Swap Market was maintained as a biweekly activity within the Living Lab, with regenerated garments continuing to circulate among community members, and some participants returning repeatedly, bringing additional garments to keep them in circulation and make them available for future workshops. This continued stream of exchanges, together with the return of participants and the inflow of new ones, suggests a gradual and partial transition from episodic experimentation to the tentative routinisation of circular exchange practices in the local context.

5.2. Quadruple Helix as a Living Process: Widespread Intentionality and Trust as Outcomes

A second contribution of the study focuses on how the QH theoretical model can be operationalised as an activator of widespread intentionality, with indicative evidence that trust can function as an outcome of the process. In its theoretical construction and initial

application, the QH is conceptualised as an organisational structure model with predefined roles based on skills and institutional mission: academia as a generator of knowledge and research, private enterprise as a provider of applications and solutions, public institutions as policy facilitators, and citizens as a receptive context or source of feedback [45,105]. However, more recent literature [106–108] emphasises how this configuration risks translating into a rigid or merely formal form of collaboration, where many implementations of QH are reduced to "recurring meetings" [106] and effective co-creation and knowledge generation are partially compromised. However, this phenomenon does not stem from a theoretical limit of QH itself, but rather from its translation into practice. According to Carayannis et al. [109], in its most evolved forms, this distribution of roles has a dynamic nature that might change based on context and the maturity levels of innovation activities.

Madeback's contribution aligns with this latter interpretation of the QH model: collaboration among universities, businesses, public institutions, and citizens has evolved over the six-month process through a design that fostered dynamic role negotiation, simultaneous knowledge generation, and a process of widespread learning [110]. This mechanism—which we refer to here as "widespread intentionality"—does not so much describe a "dual role" for each QH actor as a systemic mechanism that cuts across all four propellers: academia has produced both codified knowledge on waste patterns, reuse and recovery models, and public co-design laboratories; industry has simultaneously performed and tested innovative circular models and facilitated educational processes on conscious consumption; institutions—linked to the institutional and civic context of the NRRP MUSA project—have legitimised experimentation and amplified the connection with the territory; finally, citizens have contributed with local knowledge and active participation while acquiring both technical skills and literacy in the culture of sustainability. A critical aspect underpinning the concept of "widespread intentionality" is that functions can be distributed, and knowledge can be produced through a process that is not delivered through structured roles, but rather through a highly dynamic process involving the cross-pollination of expertise [111,112]. In this sense, Madeback can be read as a performative variation in the QH model, illustrating how co-creation and functional flexibility can be achieved where ad hoc collaborative devices and practices are in place. This negotiation was evident, for example, in the preparatory workshops for the festival, where strategic (from an academic perspective), technical (from industry, designers and artisans) and experiential (from citizens) contributions were requested and valued, creating a space where institutional codified knowledge and community knowledge actively hybridised through making practices. This resonates with discussions on distributed agency [96,113] and communities of practice [114,115], where agency is understood as emerging from networks of actors and artefacts rather than being located in single individuals.

Operationally, this widespread intentionality requires the articulation of an intentional architecture during the design phase: explicit negotiation of hybrid roles, design of formats that require simultaneous (non-sequential) contributions, creation of spaces where "error" is permitted as part of the activation and learning processes themselves. Borghys et al. [106] emphasise the need for "constant reflexivity" on the rationales and roles within QH collaborations, understood as a continuous practice of questioning and realigning objectives among the actors involved. During Madeback's six months, dedicated coordination meetings provided space for constant reflection, allowing expectations, responsibilities, and forms of contribution to be negotiated and redefined over time. With this in mind, governance in similar initiatives should be explicitly designed to support recurring moments of joint reflection, in which objectives, intentions, and roles are periodically renegotiated in light of the dynamics that have emerged in the collaboration.

Widespread intentionality concerns not only the distribution of tasks, but also the relational quality of the collaborative process. In the Madeback case, this dimension developed clearly during the preparatory months, thanks to moments of co-design that required mutual exposure of limitations, uncertainties and organisational constraints. The legitimisation of this shared vulnerability made it possible to build common ground on which to negotiate roles, expectations and objectives, going beyond purely formal cooperation between the propellers. At the same time, we recognise that this relational work unfolded within structural asymmetries: academic researchers designed the project, convened partners, facilitated many activities and conducted the analysis, which positioned academic perspectives and resources as foundational to the process.

A critical emerging element concerns the possibility of interpreting trust as an outcome rather than a prerequisite. The literature on Living Labs highlights how inter-organisational trust is not, in itself, an initial condition but instead can be the product of co-design and experimentation processes [21]. In the Madeback case, the partnership between industry, professionals and the Politecnico's Fashion & Textile Living Lab was not rigidly defined ex ante but was consolidated through shared work on concrete activities related to the festival, from defining the content of the workshops to co-curating the installations. In such cases, collaboration required not only the sharing of skills but also a willingness to re-evaluate interests and priorities. Thus, in this situated practice, the QH took on the qualities of a living process, wherein roles, relationships, and trust levels are constantly being generated, as opposed to being imposed from a conceptual framework.

From an empirical standpoint, this emergent nature of trust became visible in the consolidation of collaborations after the festival. At least one of the collaborations initiated during the preparatory and implementation phases evolved into a jointly designed new cycle of workshops involving the Living Lab, an international outdoor brand and a specialised designer. These developments point to the fact that trust and commitment did not exist prior to the project but developed gradually during its implementation. This echoes broader debates on transitions to sustainability and adaptive governance [116,117], which emphasise the importance of iterative coordination and learning across sectors [118] over fixed, one-off agreements.

5.3. Transformative Learning Ecosystems: Embodied Practices and Knowledge Co-Production

Conventional approaches to sustainable transformation are based on a transmissive model: information generates awareness, which in turn produces behavioural change. However, pedagogical and social transformation research shows that this linear model rarely produces profound changes in values [119,120]. Mezirow [119] defines transformative learning as "perspective transformation", i.e., the redefinition of the interpretative frames through which subjects understand themselves and the world, rather than the simple acquisition of new knowledge. Formenti and Hoggan-Klouber [120] emphasise that such transformation requires shifts in self-understanding, the ability to question normalised actions, and critical awareness of socially shared assumptions. In this light, Madeback can be understood less as a tool for "disseminating" information on sustainability and more as an arena that allowed its participants to test, experience, and, through practice, reinterpret their connections with objects, time, resources and relationships in a specific local context. Although the activation of these processes was documented over a six-month observation period, longitudinal research would be needed to assess whether, beyond the project's context, these changes translate into lasting shifts in meaning-making frameworks.

From an empirical perspective, transformative learning appears to have emerged as some participants redefined their relationship with clothing during and after the workshops. During the preparatory workshops and festival activities, dozens of participants engaged

in intense sessions of upcycling, visible repair, and narrative embroidery. Their feedback and the changes observed in the way they approached and evaluated repairability, time and fabric care (e.g., recognising that a garment required only minor repairs rather than being considered unusable, or beginning to see the feasibility of revitalisation techniques for garments they had not previously considered as options) suggest initial forms of perspective transformation that go beyond the simple acquisition of technical skills. At the same time, the Community Wardrobe and its Swap Market encouraged participants to return repeatedly, using the shared evaluation system as a tool for self-assessment of garments, helping them to reflect more consciously on their value, paying, for example, greater attention to aspects such as the quality of production and the composition of materials rather than their immediate fashion appeal. These reflections indicate the first changes in how some participants relate to clothing, moving beyond a purely fashion-oriented view.

The embodied dimension of participation is crucial to understanding these processes. The phenomenology of bodily experience reveals how knowledge is grounded in the gestures, postures, and spatial relationships of subjects, rather than solely in abstract and disembodied forms of knowledge [121,122]. At the same time, in the context of sustainability transitions, the European Environment Agency (EEA) emphasises the need to integrate, alongside technical and scientific knowledge, practical, contextual and tacit knowledge gained through lived experience and direct participation in processes of change [123]. In the case of Madeback, activities were not limited to informative moments: touching transformed fabrics, handling garments during repair workshops, observing or participating in visible repair sessions, participating in collective upcycling practices and in the evaluative exchanges of the Swap Market activated physical and relational dimensions that intertwined with cognitive ones, contributing to the construction of new meanings around circularity. In this context, Madeback operated as a space in which these forms of situated and embodied knowledge were not only activated but also recognised and legitimised as essential components of the transformative learning process.

The learning ecosystem generated by the festival gave rise to non-traditional forms of knowledge that are difficult to access in more rigidly organised structures. In the Madeback case, formalised knowledge—such as data on waste patterns or guidelines for circular practices—was intertwined with relational knowledge, built through repeated interactions, collaboration and growing trust between the actors involved. This was accompanied by: (i) embodied knowledge, relating to the "know-how" incorporated in the gestures of handling fabrics, visible repair and evaluation of tactile quality; (ii) "affective" knowledge, linked to the emotions aroused by caring for objects, sharing meaningful garments and recognising oneself in shared narratives; (iii) collective imaginaries, i.e., shared meanings produced performatively through the dramaturgy of the festival. The EEA [123] emphasises how heterogeneous forms of knowledge—including practical, tacit and experiential knowledge—are a crucial resource for guiding and supporting sustainability transitions; Madeback made these dimensions tangible and visible, showing how they can coexist and feed off each other within the same learning device.

In this context, learning was not simply "delivered" by experts to audiences but co-produced by multiple actors. The citizens did not take on the role of passive spectators. Instead, they participated in building the Community Wardrobe by influencing what was being distributed, were involved in co-designing during the workshops, and helped shape the festival format based on feedback. Massari et al. [108] demonstrate in their work on co-creativity in Living Labs how the combination of discursive tools with creative and material practices can broaden the involvement of actors and support richer, more inclusive co-creation processes, thereby facilitating the emergence of shared perspectives in food systems. In Madeback, academic knowledge of circularity models was combined with

the community's practical knowledge of daily clothing management, industrial expertise in supply chains and production processes, and aesthetic and cultural sensitivity to the desirability of new practices. The scale of participation—involving dozens of people in workshops, over a hundred in debates, and hundreds in exchange and visiting activities—indicates a process of partial but widespread co-authorship, which has helped to build a common lexicon and new repertoires of action.

This interpretation is part of the broader debate on learning ecosystems for sustainability. Svare et al. [124] illustrate how transition processes are supported by learning systems that combine intentional and structured pathways with more emergent and contextual forms of learning, requiring devices capable of offering opportunities for autonomous exploration while also adapting to the specific conditions of the contexts in which they operate. In this perspective, Madeback can be seen as a first, small-scale attempt in this direction: the intensive event provided experiences and tools that participants could potentially reactivate in other contexts, while the short, mediated follow-up phase and connections with institutional and community actors began to outline forms of support that could be further developed and adapted over time.

Taken together, the Madeback findings suggest a shift in analytical lens from Living Labs primarily framed as testbeds for technological, product and service innovation to Living Labs understood as sites of meaning innovation, where cultural mediation, trust-building and co-produced learning sit alongside user-centred prototyping, stakeholder engagement and policy testing.

6. Conclusions

This article has systematically documented the application of the LLIP at the Madeback Circular Fashion Festival, with a view that analysing the role that collaborative research and innovation infrastructures can play as catalysts for transition in the fashion system towards a cultural shift towards circularity. From empirical insights gathered over six months between May and November 2025, the study suggests how a fashion-oriented Living Lab may mobilise performative, relational and learning mechanisms to support this cultural reorientation and outlines three interrelated findings that tentatively redefine the theoretical and operational concepts of Living Labs in the realm of complex, sustainable transitions.

Firstly, the study indicates that Living Labs may function as cultural infrastructures rather than purely as devices for solving technical problems. In Madeback, the activation of circular practices did not appear to be solely the result of deploying technologies and procedures for waste treatment but was embedded in the deliberate construction of a performative and narrative dimension that made circularity culturally desirable and tangible. In this regard, the Living Lab infrastructure does not simply "host" an event format but provides the organisational continuity, curatorial capacity and reflexive space through which performative interventions such as Madeback can be repeatedly designed, tested and adjusted over time. This reading of Living Labs widens the LLIP approach, insofar as it posits that the deliberate exploitation of the performative dimension—aesthetic, narrative and ritual—may operate as an active element in the normalisation of alternative meanings, rather than as a merely communicative accessory; integrating this performative-cultural work into Living Lab design appears to emerge as an important methodological element for transitions that involve deep cultural change.

Secondly, the way QH operates in Madeback illustrates how the model can function as a practice involving broad intentionality, with dynamic and negotiable roles, and with trust not treated as a prerequisite but as something that emerges through concrete processes of co-creation. Academia, industry, public institutions and citizens did not operate according to separate mandates but contributed simultaneously to multiple functions. From this

perspective, trust and widespread intentionality can be read as emergent outcomes of the Living Lab infrastructure, which provides relatively stable relational settings, governance routines and opportunities for repeated interaction beyond the temporality of the festival. The configuration of this QH's "living process", characterised by shared vulnerability and continuous negotiation of roles, differentiates Madeback from more rigid collaboration models and, in this context, has generated post-event partnerships that signal an initial consolidation of relationships beyond the pilot intervention.

Thirdly, the festival has operated as a transformative learning ecosystem that integrates formalised knowledge, embodied practices, relational knowledge and collective imaginaries. Direct involvement in upcycling, repair and exchange practices, combined with discursive learning through conferences and conversations, seems to have initiated perspective transformations that go beyond transmissive conceptions of sustainability education. Essentially, this learning ecosystem cannot be reduced to a one-off "event", but is based on the Living Lab's ability to support follow-up activities, keep narrative materials and artefacts in circulation, and translate experiential insights into constantly evolving practices and guiding principles. In the case examined, learning was co-produced by heterogeneous actors, not provided top-down by experts, generating forms of situated knowledge that would be difficult to access in more rigidly organised structures.

Together, these three dimensions outline a mechanism through which Living Lab infrastructures can contribute to sustainable cultural transitions: performative and narrative interventions make alternative practices visible and desirable; QH operates as a living process that distributes intentionality and gradually builds trust; and a transformative learning ecosystem allows actors to reformulate meanings, capabilities and relationships around circularity in ways that, over time, may stabilise new social norms.

The actual results, however, are framed by specific contextual factors that limit their transferability. The Madeback project was developed at an internationally recognised design-oriented university, supported by multi-year funding and integrated into a local ecosystem with an established community of designers and artisans, within the context of a permanent Living Lab. These conditions allowed for a medium- to long-term time horizon, design expertise and organisational continuity that shaped the project. In contexts with more limited resources or without a local creative ecosystem, the implementation of similar models would likely require significant adaptation of roles, formats, and expectations. Moreover, the empirical evidence covers a six-month timeframe, within which it is possible to document the activation of practices and early system dynamics, but not their long-term consolidation. More stringent evaluation practices should therefore involve follow-up assessments over a period of two to three years in order to assess whether the observed shifts in circular thinking, partnership configurations and community engagement persist, evolve or dissipate. Although highly dependent on context, a number of minimum conditions for implementing similar initiatives can be drawn from the Madeback experience. First, a basic infrastructure similar to a Living Lab or host organisation is needed to support coordination, documentation and reflective evaluation beyond a single event. Secondly, a core network of actors from different parts of QH must be willing to experiment with hybrid roles, shared vulnerability and forms of collaboration that are not purely transactional. Thirdly, a minimum capacity to design and curate performative and narrative formats that translate circularity into meaningful local experiences is necessary, as dissemination cannot be left to a residual task. Under these conditions, Living Labs can begin to operate as cultural infrastructures that support early, situated forms of cultural and behavioural change around circular fashion.

Despite these shortcomings, the work contributes to defining a set of essential operating factors for Living Labs for sustainable and cultural transitions, namely: the conscious

integration of performative aspects into methodological design; the explicit design of collaborative architectures that embrace widespread intentionality and collective acceptance of uncertainty; and the intentional combination of formal learning structures with spaces for contextual emergence. From an operational perspective, these factors suggest that practitioners and designers can use the LLIP framework not only to structure prototyping activities, but also to intentionally script performative, material and narrative elements that support meaning-making around circularity. Policy makers can consider Living Labs as mediation infrastructures that can help translate macro-level priorities (such as the Sustainable Textile Strategy and the Green Deal measures) into locally rooted experiments; and Living Lab facilitators can design governance models that favour continuous role negotiation, vulnerability sharing and iterative learning rather than one-off consultations.

In terms of policy relevance, the Madeback case illustrates how an institutionalised Living Lab can connect European macro-strategic priorities with concrete practices and experiments. Rather than viewing Living Labs as mere add-ons to specific projects, the case points to the value of resourcing them as long-term infrastructures that host regulatory experimentation, cultural mediation, and iterative learning. This is particularly evident in the fashion and textile sector, where emerging regulatory frameworks already require new capacities for collaboration, monitoring, and learning that go beyond simple compliance. In this sense, Madeback's insights suggest that future policy design could explicitly recognise Living Labs as places where policy objectives, cultural practices and everyday experimentation are negotiated together, and where cultural and learning outcomes are evaluated alongside more conventional performance indicators.

Future research directions include: (i) assessing the persistence of behaviour change and the level of network development over a 12–18-month period, in order to distinguish transient impacts associated with micro-experiments such as Madeback from more durable change and meso-systemic scaling; (ii) replicating the model in varied geographic and sectoral contexts to identify key variables that influence its success and boundaries of applicability; (iii) further investigating the nexus between micro-scale experiments, meso-level dynamics and the impact associated with Living Lab networks, including the diffusion of narrative impacts; and (iv) empirically analysing how Living Labs can operate as infrastructures of resistance to dominant fashion narratives, developing alternative imaginaries that may progressively embed themselves in everyday cultures, in ways that longitudinal research will need to examine more systematically.

In conclusion, this study contributes to defining the role of the Living Lab as a potential means of cultural transition, in which innovation, governance, learning and meaning-making occur through processes of co-evolution. In the context of the green transition and the complex socio-technical transformations that characterise the present, the value of Living Labs lies in their ability to make room simultaneously for methodological rigour and emerging experimentation, regulated processes and creative freedom, macro strategies and local roots. The challenge facing future research and policy is to promote the dissemination and interconnection of such infrastructures, not as isolated cases, but as co-evolutionary systems capable of triggering fundamental transitions towards more sustainable and equitable production models and consumption practices.

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Institutional Review Board Statement: Ethical review and approval were not requested for this study, due to the nature of the participatory action research and the data collection procedures employed. Implicit informed consent was obtained from all workshop participants, festival visitors, and stakeholders through clearly communicated information about the research purpose and data usage displayed at the event venues and distributed in advance communications. All personal data collected during the Madeback Circular Fashion Festival have been processed in compliance with the GDPR and the University's Code of Ethics, according to the principles of consent, data minimization, and pseudonymisation. It is not possible to trace the identity of individual participants in the research findings; personal data are not subject to publication. Documentary evidence (photographs, video recordings) was collected exclusively for research and dissemination purposes with explicit consent from identifiable individuals featured in visual materials.

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study. Specifically, written consent was collected from stakeholders and workshop participants, while festival visitors were informed about the research context and the possible use of photographic and video documentation through information notices displayed at the event venues.

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Abbreviations

The following abbreviations are used in this manuscript:

LLIP	Living Lab Integrative Process
MUSA	Multilayered Urban Sustainability Action
NRRP	National Recovery and Resilience Plan
QH	Quadruple Helix
RtD	Research through Design

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