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Dealing with Complexity: Architectural Co-design Strategies in At-risk Contexts

*By Francesco Airoldi**

The paper starts from an ongoing PhD research on architectural co-design in at-risk contexts and reflects on aspects of contemporaneity that architecture can address by considering the complexity of the systems that characterize the built environment: that of natural risk and its relationship to uncertainty, within the cultural debate on risk society and its current conditions of polycrisis and permacrisis. The community-based approach suggested by the general framework of the scholarship, the PNRR MUR RETURN project, is geared towards architectural co-design and is considered essential in multi-risk scenarios such as that of the Lomellina region, which is the subject of the proof of concept of the study. Here, the research proposes a co-design-driven methodology based on transformative participation and spatial co-production to achieve more equitable antifragile conditions and risk awareness through spatial common education of professionals, users, clients, and the general public. The work emphasizes how the construction of a shared knowledge can underpin effective spatial transformations with bottom-up orientations. This is a necessary condition for the formulation of strategies that project design disciplines towards ex-ante temporalities, in order to deal with complexity of at-risk contexts before, during, and after disasters.

Keywords: *Co-design, Risk, Architecture, Permacrisis, Participation.*

An Architecture of Permacrisis[1]

«Bref, les espaces se sont multipliés, morcelés et diversifiés. Il y en a aujourd'hui de toutes tailles et de toutes sortes, pour tous les usages et pour toutes les fonctions. Vivre, c'est passer d'un espace à un autre, en essayant le plus possible de ne pas se cogner» (Perec, 1974, 12)[2].

As early as 1974, Georges Perec noted some of the spatial consequences of contemporary contradictions in one of his most famous books. Reading *Espèces d'espaces* it can be realized that, today more than ever, space has become an uncertain element: natural disasters, financial crises, and epidemics, have profoundly redefined the social and environmental challenges by affecting the design of space and its needs for transformation. These contradictions are related to

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1. The title of the paragraph refers to the author's contribution "Towards an Architecture of Permacrisis" in Corradi E (ed.) (2025) *Oltrerischio. From resilience to antifragility: architectures, practices, communities*. Siracusa: Letteraventidue.

2. «In short, spaces have multiplied, fragmented and diversified. Today, there are spaces of all shapes and sizes, for all uses and functions. To live is to move from one space to another, trying as much as possible not to bump into each other» (Perec, 1974, 12) (English translation by the author).

a new idea of the ordinariness of emergency, which projects uncertainty into a dimension of everydayness. They contribute to drawing scenarios in which the articulation of space-society system presents unprecedented degrees of complexity.

Over the past decades, cities and territories have undergone radical changes, both in their definition and spatial configuration. The uncertainty permeating them has always been a factor of fragility, especially that related to climate change-induced risks. Today, the accelerated return times of disastrous natural events and their increased intensity are phenomena that generate «new geographies» (Galderisi, 2020) and increase spatial inequalities around the world (Lobao & Hooks, 2025). Furthermore, the overlapping of different hazards in the same place resulting in complex multi-risk scenarios, generates economic disparities and amplifies the processes of abandonment, depopulation, and underuse. The role of architecture and urban planning, within design cultures, is to read and interpret these circumstances by juxtaposing the goals of risk adaptation and preparedness with those of mitigation and reduction of it.

Given these premises, an initial research question arises: how can architectural design methodologies be reimagined to effectively address the spatial uncertainty and the everydayness of emergency?

Dealing with complexity – relating to risk and uncertainty – in contemporary architectural debate means approaching the project with a range of interconnected topics, intersecting different disciplines, expertise, and research areas with a flexible attitude. An exchange between various skills, fields of knowledge, and common sense capable of abandoning the typical modern dualisms towards a reformulation of the subject and the subject-object relationship. At a cross-disciplinary level, it is about defining a set of mutual dependencies that does not refer to hierarchical structures or binary oppositions, a fluid system well described by Donna Haraway with the «cyborg» metaphor (1991). The proposed dynamic vision invests both the «spatial agency» of the architect in his activity and sensitivity, and the meaning of architecture understood as an «agent» itself (Awan et al., 2011). In this sense, the increasing uncertainty about the future must confront the idea of stability and permanence of which architecture has always been a symbol: if classicism and modernity have directed art-historical periods and currents between interpretation and prediction, the 21st century represents the era of indeterminacy. And – as a second research question – architects should ask themselves: is it possible to transform this state of generalized uncertainty into a design driver?

Figure 1. *Risk Diagram: A Spatialization of the Problem*
Source: Graphic work by the author.

To try to answer this question, it may be useful to think about the temporalities of risk understood in its probabilistic conception permeated by uncertainty and which defines it in the components of hazard, exposure, and vulnerability (Balducci et al., 2020) (Figure 1). The time of risk is structured on a sequence of «before, during and after disasters» (Lari et al., 2013), which specific actions of the project can correspond to. In this framework, the "before" dimension is a less studied temporal aspect: it relates to a possibility of forms and space, directing the design gaze to risk exposure and vulnerability, the components it is possible to operate on through spatial transformations; while architectural approaches to the "during" temporality – usually transitory and flexible interventions to address housing emergencies – and to the "after" one – reconstruction plans that are hopefully based on a reinterpretation of the identity and memory of places – are deeply rooted in architectural and urban planning culture. In reference to the multiplicity, frequency, and intensity that characterize the topics of risk, combined with the complexity of multi-risk scenarios, the main necessary changes in the assumptions of design disciplines concern the conditions, methods, modalities, and times of transformation (Miano, 2024). The need is to act first in the direction of risk adaptation and preparedness for uncertainty, to foster new antifragile conditions (Taleb, 2012) for territories and communities. Architecture is called upon to reflect these challenges as a matter of space and place's transformation: this means to redefine the horizons of spatial research by broadening the disciplinary debate, merging risk and design temporalities.

The relevance of these issues within the contemporary architectural culture does not only belong to recent academic or design-driven research[3], but is evidenced by the expressive urgency of some young practitioners and researchers too. They are often organized in the form of collectives or small architectural firms, and their cultural production helps to open the eyes to the condition of «permacrisis» that characterizes today's reality and is a key factor to understand the above-mentioned crisis of space (Fosbury Architecture, 2023)[4]. «Permacrisis» is a term derived from «polycrisis» (Morin & Kern, 1993), now used to denote in different fields the condition of permanence of uncertainty that requires adaptation rather than a contrasting approach. It is a legacy of the German sociologist Ulrich Beck, who theorized the features of risk society in his famous essay *Risikogesellschaft: Auf dem Weg in eine andere Moderne* (1986) by defining its temporal, spatial, and social indeterminacy: talking about risk from this point of view allows us to define a spatio-temporal placement of project tasks and actions, implementing a change in design perspective. For Serge Latouche (2007), permacrisis is a perennial disease that accompanies capitalism, which is assuming an ever-increasing complexity and globality. It is therefore the last stage in the evolution of the meaning of the term "crisis", which constitutes a cultural basis for an effective awareness of nowadays problems, but on the other hand its often-made abuse raises some concerns. As Sara Gangemi points out, the continuous reference to the crisis at the institutional and mediatic level could prove instrumental in justifying a certain deprivation of space, time, and resources: this could legitimize those who govern the territory to employ emergency tools rather than cultural policies and complex projects that look to the long term (Gangemi, 2019). Therefore, the urgency is to consider the characteristics of risk society in their very essence, as a background for every design action or a context that is not only physical but also socio-economic and cultural, which the transformations of space must necessarily look to, towards an architecture of permacrisis. It means operating in the *ex-ante* temporality, making uncertainty a design possibility through the strength of choice in multi-risk and emergency scenarios. Moreover, in ancient Greek the word *κρίσις* (krisis) means "choice", "decision", "turning point", or "separation", and it is the basis of the meaning of the term in English, indicating a moment of need to choose, decide, or change (Illich, 1978).

Operating in *ex-ante* temporality on risk reduction and mitigation, and on adaptation to multi-risk scenarios, means considering the complexity of the land-community system as a proper design matter. And this is where the third research question lies: can community engagement be an alternative in architecture capable of generating transformations that are sensitive to the contemporary state of permacrisis?

The last question can reveal interesting interpretations of the disorder typical of our relationship with the environment – or a more complex order – that Colin

3. E.g. *Terre Fragili* by Marco Navarra and Liliana D'Adamo or *Paesaggi a Rischio* by Pasquale Miano and Bruna Di Palma (in the final bibliography).

4. An example of cultural production is the Italian Pavilion curated by Fosbury Architecture at the 18th Venice Architecture Biennale, which ran from May 20 to November 26, 2023 and was called *Spaziale: Everyone Belongs to Everyone Else*.

Ward includes together with the vernacular, ecological, adaptive, countercultural, and syndicalist alternatives (Ward, 1976). In this vision, which calls for a paradigm shift in architecture, possible design actions in at-risk contexts cannot be considered just in their technical dimension but must concern community-based strategies (Fraschini et al., 2024). A dialogue between specialist skills and the common sense of people is necessary for the construction of shared knowledge that lays the foundations for a widespread risk culture. And since architects, clients, users, and the general public share the same problems as «architecture's public» (De Carlo, 1992), they must share the same space during design temporalities.

> «As Hans Gadamer put it so well – in *Truth and Method* – mutual understanding is achieved by a "fusion of horizons"; cognitive horizons, which are traced and broadened by accumulating life experiences. The fusion that a mutual understanding requires can only be the consequence of a shared experience; and one can hardly think of sharing an experience without sharing a space» (Bauman, 2003).

A shared understanding of the complexity of contexts subject to risk and uncertainty is a key aspect of building that knowledge which can underpin participatory approaches towards co-design with a bottom-up orientation. This is a necessary condition for the formulation of strategies that project architectural practice in an *ex-ante* temporality, moving away from the *ex-post* tendency of contemporary policies of interventions that often fail to interpret the needs of fragile communities.

Co-design and Risk through Literature Review and Best Practices

Although co-design and risk – the two main topics of this contribution –both have an extensive scientific literature of reference, they are not so frequently intersected in contemporary research. Since they are topics with a strong spatial connotation, the architectural debate is quite florid on both fronts, moving in very different subject areas and showing a plurality of disciplinary interests. However, while co-design is often addressed from an urban planning or participatory policy perspective, when the scale of interest becomes architecture the case studies mainly concern interventions in urban and neighborhood contexts. Here, the communities have needs related to housing typologies, quantity of space, and quality of built environment. In these areas of interest, risk and uncertainty are usually placed in the background and treated – when it happens – only from a climatic-environmental point of view and almost exclusively in the domain of open space design. On the other hand, when risk is not studied from a purely theoretical – philosophical or scientific – point of view, it is mainly investigated in reconstruction scenarios. When invested with its characteristic spatial connotation, it is addressed with *ex-post* approaches to architectural and urban design that involve the temporality of the disaster with emergency logic.

Architectural research can link co-design and risk finding an intersection of the two bibliographic frameworks around the spatialization of problems within the built

environment (Figure 2). More precisely, this concerns the role of communities in common education on the use of space through its transformation.

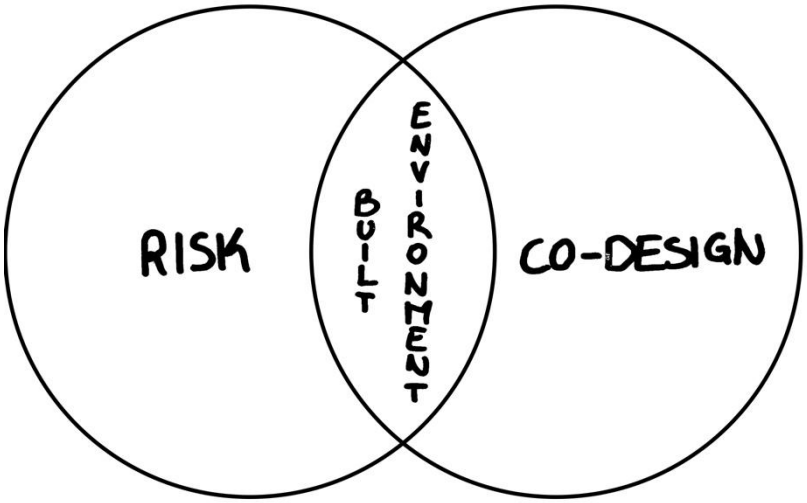

Figure 2. *Risk and Co-design: Intersection of the Spheres of Knowledge*
Source: Graphic work by the author.

Starting from the interest that arose in the 1970s for the user-centered architectural design and urban planning, the theoretical and practical contributions of some designers such as John F. C. Turner, Giancarlo De Carlo (1972), Lucien Kroll (1996), and Ralph Erskine, evolved by combining the strong political connotation that characterized it with a sensitivity to the issues of living. Experiences such as Community Architecture (Wates and Knevitt, 1987), informed by the theorization of participatory practices (Arnstein, 1969; Davidson, 1998) and by the use of innovation in tradition (Fathy, 1973), have changed into the contemporary practices of engagement and empowerment, with a renewed focus on the needs of people, animated by the conception of space as a common good (Druot et al., 2007). Moreover, in recent years, some contemporary researchers and architects have contributed to redefining the lineaments of co-design, moving away from the past patterns in the direction of active community creativity. This horizon stems from an idea of participatory architecture as a cultural issue (Marini, 2013, 33), a reinterpretation of 20th century experiences, and a theorization of collective practices (Jenkins and Forsyth, 2010) reinvigorated by a new vision of problematizing reality. In this sense, a «transformative participation» (Till, 2005, 27) – understood as a bridge between participation and co-design – redefines a community-based approach sensitive to the complexity of reality, contextualizing shared knowledge and providing a more real vision of communities (Till, 1998). It has the power to reshape the role of architects in the application of specialized culture, design, and spatial thinking (Figure 3).

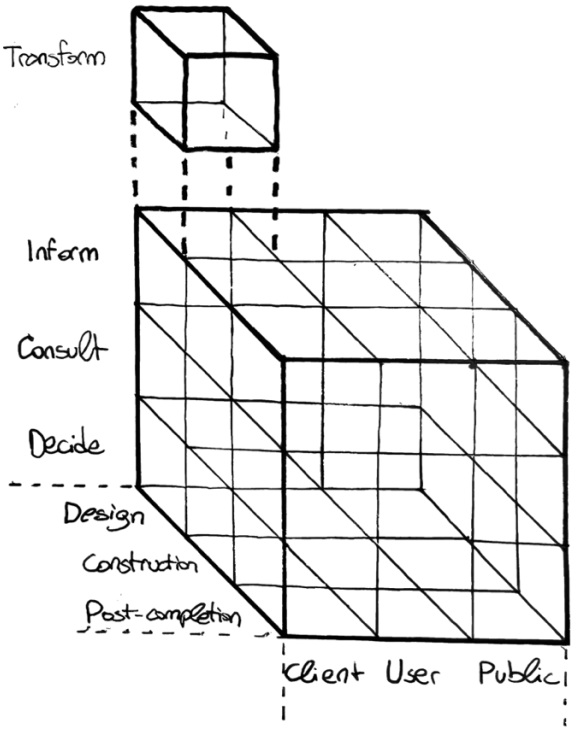

Figure 3. *The Role of Transformative Participation within the Design Process*
Source: Jenkins P, Forsyth L (2010) *Architecture, Participation and Society*. London: Routledge, 14. (Graphic reworking by the author).

On the other "side of the coin" the connecting element between risk literature and architectural co-design lies in the spatial translation of natural disaster issues, a factor that strongly links the fragilities of territories and communities under the same pattern of problems. In this sense, it is useful to look at the national and international measures on environmental risks published in recent years, in order to understand local and general trends and priorities. Today, the interest in disaster risk reduction (DRR), disaster risk mitigation (DRM), and climate change adaptation (CCA) has grown exponentially: witness the birth in 1999 of the United Nations Office for Disaster Risk Reduction UNDRR, an UN agency dedicated to them. The essentiality of these issues to the achievement of the sustainability goals of the European and international agendas is historically supported by the numerous documents that since the mid-1990s have defined priority areas of intervention, actions, and goals for DRR, DRM, and CCA. They are the 1994 *Yokohama Strategy and Plan of Action for a Safer World*; the 2002 *Johannesburg Declaration*; the 2012 UN Conference on Sustainable Development outcome document; the *Hyogo Framework for Action (2005-2015)*; and the *Sendai Framework for Disaster Risk Reduction (2015-2030)*[5]. These documents, starting from a link between natural

5. References at UNDRR website: www.undrr.org (last access: January 2024); UN website for *Johannesburg Declaration*: www.un.org/esa/sustdev (last access: September 2024); UN Sustainable Development Goals: www.sustainabledevelopment.un.org (last access: September 2024).

disasters and sustainable development, contributed to the understanding of risk and climate change adaptation as key challenges. They suggest addressing them with spatial transformation and planning highlighting the role of architectural design in the development of proactive policies and strategies. This is evidenced by numerous recent urban transformations, such as the *Watersquare Benthemplein* in Rotterdam by De Urbanisten (Figure 4).

In Italy, the 2017 *Strategia Nazionale per lo Sviluppo Sostenibile* recognized those on DRR, DRM, and CCA as key investments for the future. In order to effectively prevent the impacts of natural and anthropic disasters, the document stresses the need to link territorial development and regeneration with the production of resilience. However, today, despite the accessibility of huge databases such as the *Disaster Risk Management Knowledge Center (DRMKC)*, the national interest in these issues within the disciplinary debate around the project still seems rather low[6].

In architectural research on risk and co-design, literature review must necessarily be accompanied by a study of best practices that direct the work towards a design-driven cultural environment. The process of case study analysis is considered necessary along the research path because of the lack of specific literature that effectively unites the two macro-topics of co-design and risk at the scale of architecture. In this sense, as examples of virtuous episodes of participation and adaptation for DRM and DRR, some experiences of designers who investigated the potential of community engagement to achieve antifragility in contexts subject to natural risk are reported in the following lines. The selection, which covers different regions and cultural contexts, was conducted by seeking out stories – rather than individual episodes – that combine the two spheres with *ex-ante* «transformative» approaches (Till, 2005) to spatial «co-production» (Petrescu, 2005): architects and researchers who have made community-based dynamics a *file rouge* running through a huge part of their entire work.

6. References at Ministero dell'Ambiente e della Sicurezza Energetica, *Strategia Nazionale per lo Sviluppo Sostenibile*: www.mase.gov.it/pagina/national-sustainable-development-strategy (last access: September 2024).

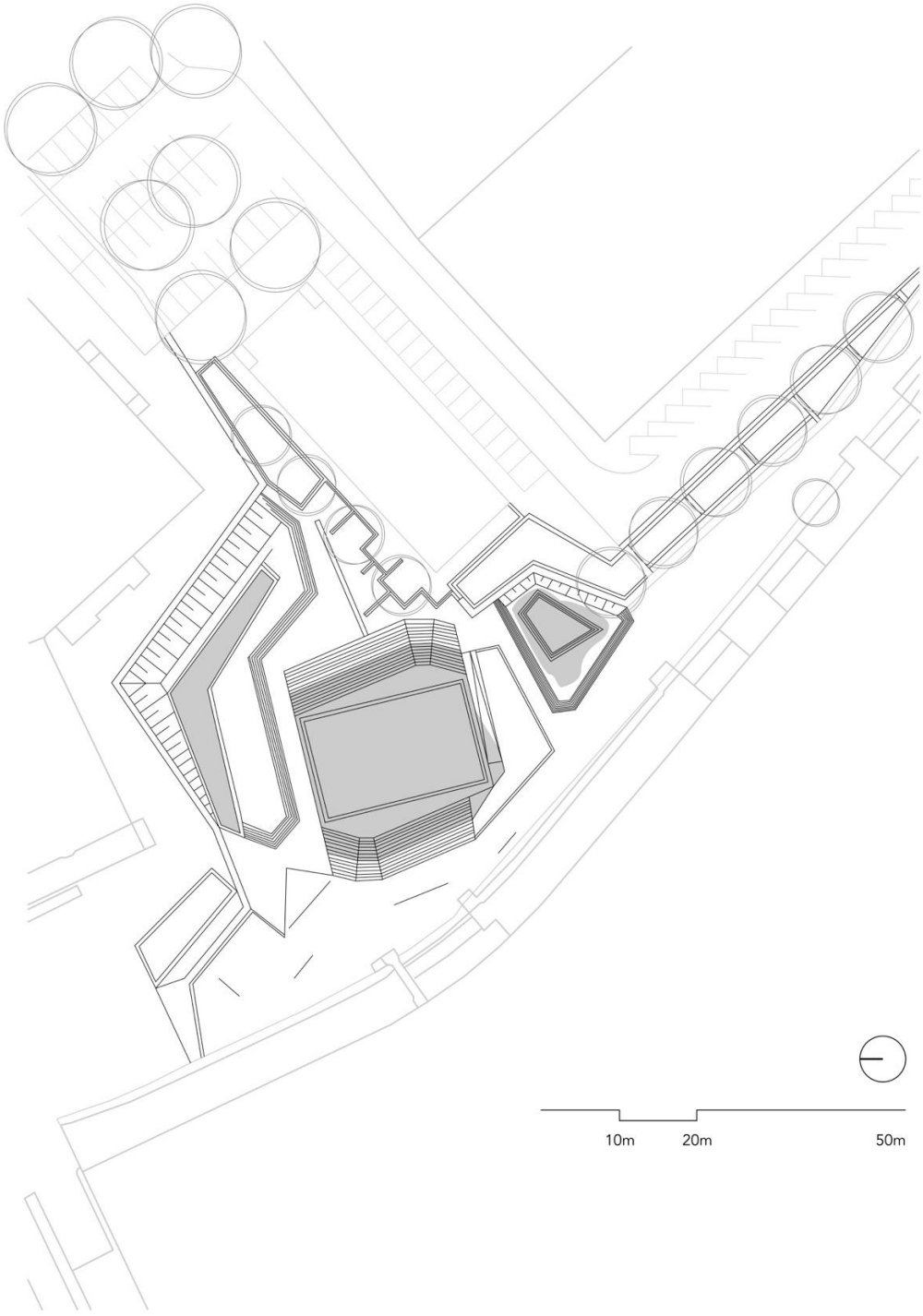

Figure 4. *De Urbanisten, Watersquare Benthemplein, Rotterdam (The Netherlands), 2011-2013*
Source: Graphic redrawing by the author.

The first experience is by Marco Navarra from NOWA[7], who investigated the topic of risk in a design way within the *Riparare Fiumare* research. The book *Terre fragili: Architettura e catastrofe* (Navarra and Adamo, 2017) recounts the entire work and the processes that led to the *Strategic Project for Giampilieri* (Figure 5), a village in the province of Messina affected by a flood and landslide in 2009. After the catastrophic event, the intuition of working through a dialogue between designers and community – linking the specialists' knowledge and citizens' common sense – proved to be successful: the community contributed to the identification of needs and requirements, increasing its awareness of risk through cooperation and communication. This was possible thanks to the organization of different on-field workshops and the distribution of some independent press papers for a sincere description of the emergency. Together with this, a shared narration of the project during the different phases of the research aimed to shift the point of view from the catastrophe to the knowledge of the territory (Navarra & Adamo, 2017) for an effective participation in the development of spatial strategies. In this way, the research group tried to overturn the paradigm according to which the safety from landslides and floods can find solutions exclusively in the field of specialist disciplines and engineering techniques (Miano, 2024).

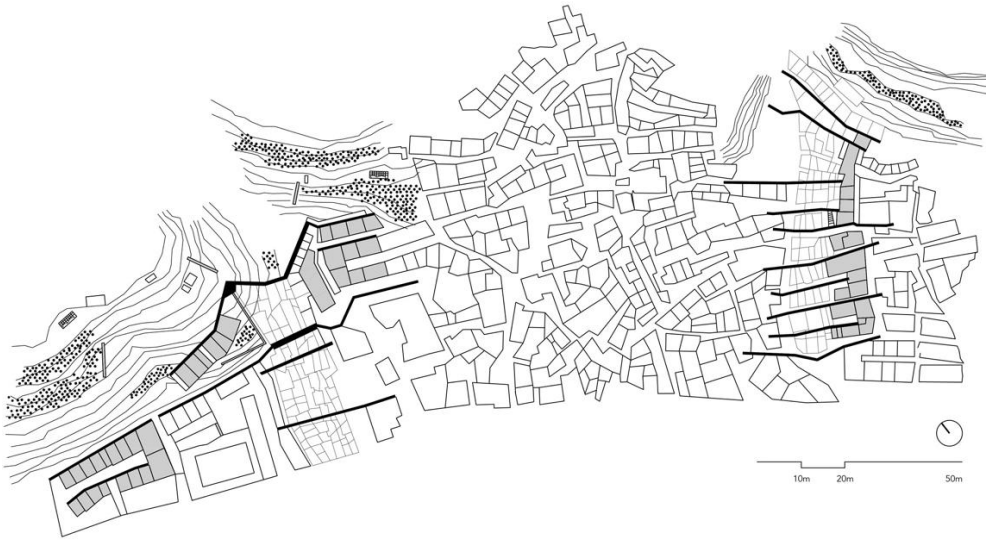

Figure 5. *NOWA and Riparare Fiumare, Strategic Project for Giampilieri, Giampilieri (Italy), 2009-2017*
Source: Navarra M, Adamo L (eds) (2017) *Terre fragili: Architettura e catastrofe*. Siracusa: Letteraventidue, 186-187. (Graphic redrawing by the author).

A second inspiring experience concerns a non-Western context, that of the 2005 Kashmir disaster and the activity of Pakistani architect Yasmeen Lari. The humanitarian work as a designer and the engagement of communities in the post-earthquake reconstruction and emergency is central for the formulation of the

7. See www.studionowa.com (last access: November 2025).

Barefoot Social Architecture (BASA), an «holistic ecosystem of multidisciplinary actions» that «make use of appropriate technologies to enable vulnerable communities to withstand predictable disasters […] and plan disaster preparedness, prevention, and management through sustainable zero- or low-carbon methodologies» (Cozza in Berlingieri et al., 2021). Architectural co-design of self-built housing modules (Figure 6), open spaces, shelters, shared furniture, and subsequent public buildings, made possible a common spatial education of disaster-affected people. It increased an awareness of risk that goes hand in hand with the self-determination generated by self-construction practices, conducted using in contemporary ways some traditional techniques and knowledge. The bottom-up orientation proposed for this regeneration project is witnessed by the *Disaster Preparedness Manual,* edited by Lari with the contribution of the Heritage Foundation of Pakistan and other researchers (2013). The community engagement in adaptation to natural risks is achieved by communication through simple images, cartoon-like drawings commented in both English and Urdu, that clearly represent the possible damage caused by hazards, the correct use of space, and the behaviors to adopt in case of emergency.

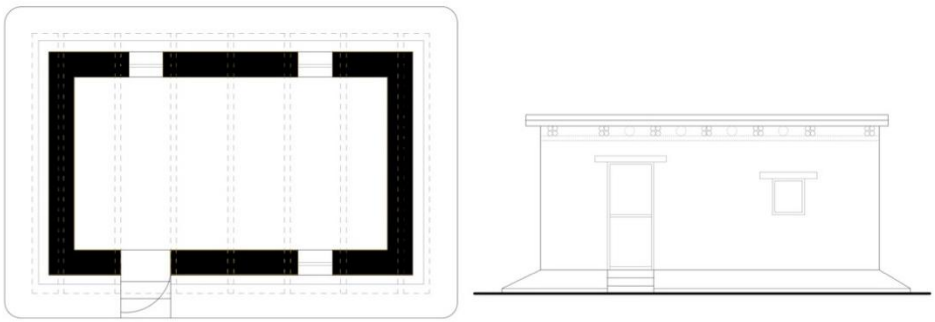

Figure 6. *Yasmeen Lari, Karavan Ghar, Kashmir (Pakistan), 2005*
Source: Lari Y, Meadows A, Meadows PS (2013) *Disaster Preparedness Manual*. Karachi: Heritage Foundation of Pakistan, 4. (Graphic redrawing by the author).

In Japan, the presence of frequent extreme events – especially seismic and volcanic – led many architects to deal with complex territories and communities in at-risk conditions, becoming for many of them a real design-driven research interest. This is the case of the numerous anti-seismic architectural interventions by Shigeru Ban developed with community-based processes, or the example of Atelier Bow-Wow's ethnographic approach (Kaijima et al., 2018) in their design experiences of adaptation to the place. In many cases, this attention to emergency issues translates into the creation of networks of architects working on the same urgencies, e.g. the Voluntary Architects' Network VAN or the Home For All project[8].

Moving to the South American experiences, *Semillas Peru* and Juan Carlos Bamba are emblematic examples of a community-based approach that links

8. See www.shigerubanarchitects.com/van and www.home-for-all.org (last access: November 2025).

moments of co-design and self-construction in at-risk rural areas. In the first case, the NGO founded by the Italian architect Marta Maccaglia develops humanitarian projects through workshops that combine the specialist knowledge of professionals with the activity of architecture students from all over the world, in perpetual dialogue with the future users – the indigenous communities of the Amazon. The projects of *Semillas Peru* often concern buildings with a social dimension and public function such as schools, canteens, hospitals etc., based on community needs and developed with participatory processes in all the design phases (Figure 7) [9].

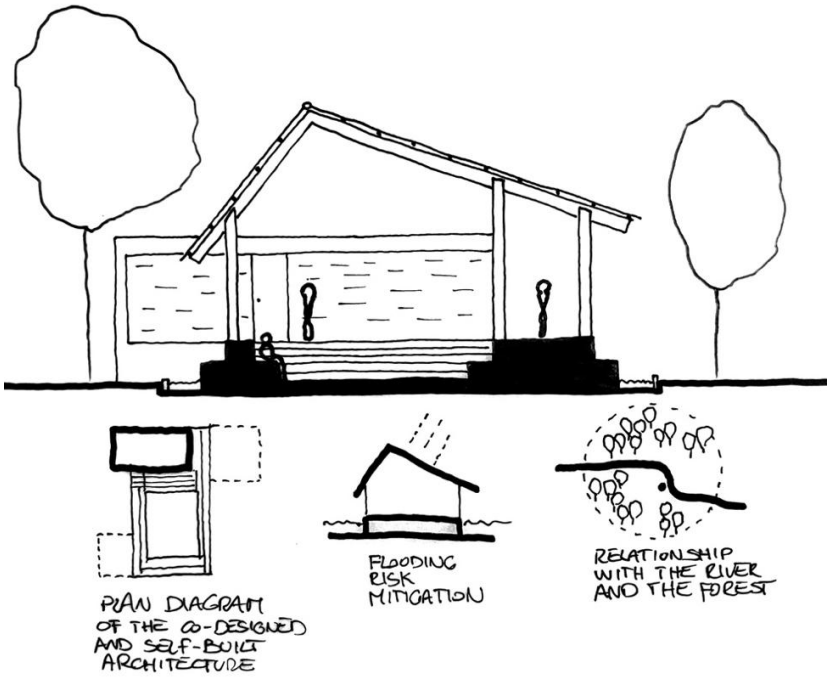

Figure 7. *Semillas Peru, Community Center, Otica (Peru), 2019*
Source: Semillas Peru website: www.semillasperu.com (Graphic redrawing by the author).

In the second case, the Spanish architect Juan Carlos Bamba and his collaborators work on community-based architectural projects in fragile contexts with the direct participation of future users through continuous moments of discussion. His floating houses, built in Ecuador with simple techniques and the engagement of local workers, represent an interesting effort in the direction of CCA. Participation in architectural design up to the building phase through self-construction is a widespread practice in South America, as demonstrated by the experiences of *Grupo AL BORDE* by David Barragán and Pascual Gangotena in Ecuador; Rafael Iglesia in Argentina; Solano Benitez in Paraguay; Eugenio Ortúzar and Tania Gebauer in Chile; and Nivaldo Vieira de Andrade in Brazil (Calabrese, 2014).

To those mentioned, many other contemporary experiences of co-design and transformative participation in at-risk contexts could be added. Some examples are

9. Ref. to Semillas Peru website: www.semillasperu.com (last access: June 2025).

those of Eko Prawoto in Indonesia, Hsieh Ying-Chun in Taiwan, ELEMENTAL and Alejandro Aravena in Chile, who have dealt with self-construction and incremental design in fragile conditions; Architects Without Borders, Technical Assistance Organization Pilipinas (TAO-Pilipinas), Architects Designers and Planners for Social Responsibility (ADPSR in USA), or other organizations of professionals and researchers who are interested in developing resilient strategies that concern the transformation of space; the Italian realities of *Laboratorio Alta Valle Aterno*, *Orizzontale* with *La Rivoluzione delle Seppie*, the collective *VIVIAMOLaq* etc.

These experiences, together with the literature review, aim to inform a co-design-driven research methodology sensitive to contemporary issues and inserted in a broad multidisciplinary structure. It will be illustrated in the next paragraphs.

A Macro Research Project and a PhD Thesis: Methodology

One of the possible application fields of architectural co-design and transformative participation on contemporary urgencies is the spatial common education on risk and uncertainty through people engagement in the transformation processes. To make this happen, architects must have «the ability to move between the world of experts and user», as an «organic intellectual, a new form of professional» (Till, 2005). The topic concerns, in this case, some design-driven research with community-based approaches pertaining to the Task 7.4.4 of PNRR MUR RETURN project, *New approach in integrated planning based on co-design processes for DRR and CCA policies* [10] – which focuses on the integration of planning strategies to identify vulnerable and safe places, and an educational process of communities towards risk prevention – and the author's PhD thesis in progress entitled *Co-design. Theories and practices for transformation, mitigation, and resilience*[11].

The two research projects are linked together by a scholarship. The methodology proposed in the PhD thesis starts from an observation of the structure of the RETURN project, identifying the role of a doctoral research on architecture within a multidisciplinary program[12] as the one funded by the Italian PNRR[13]. In fact, while the involvement of different knowledge enables the formulation of a consistent theoretical corpus and very broad fields of application, the spatialization of issues related to natural risks turns out to be an urgency that needs to be applied in all the spheres of the subject. Within the place-community pair, understood as a

10. PNRR Extended Partnership RETURN research. *Multi-Risk sciEnce for resilienT commUnities undeR a changiNg climate - TS3.* The author is involved in some WPs, especially in the WP4 entitled: *Community-Based approaches, co-design and policies.* RETURN Foundation website: www.fondazionereturn.it (last access: May 2025).

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12. To give a size of RETURN project, the entities involved in Spoke 7 TS3 are UNIFI, CIMA Foundation, PoliMI, UniMI, UniBA, UniKORE, EURAC Research, UniROMA1, UniCA.

13. PNRR is the acronym for *Piano Nazionale di Ripresa e Resilienza*, Italy's strategic plan for obtaining funds from the European Next Generation EU program, which aims to support economic and social recovery after the COVID-19 pandemic.

spatial dimension of the possible exposed elements, the research stresses the topic of identity from the perspective of mending the co-evolutionary bond between people and territories. Architectural design is thus considered as a space of collective engagement, giving participation a key role in the process: the study reflects on the possibilities of community agency to trigger or catalyze transformative dynamics of change in fragile contexts, proposing a design-driven research methodology based on co-design practices, that stems from the synthesis of two relevant design approaches: an analytical-synthetic one and a participatory one.

The first addresses issues of risk assessment, management and communication, along with the typological-morphological study of the places and the use of data and cartography to dimension its territorial incision. The urban form of settlements is an important object of study in this discourse because it allows us to identify certain correlations between exposed elements and to evaluate their spatial vulnerability to different typologies of hazards. Even more in these contexts, territorial morphology and sections become real operational tools indispensable for architectural design: their in-depth definition and understanding allows for the management of certain risks through design and drawing. These elements, which can be investigated through mapping and other graphical representations (e.g., photography, sketches, technical drawings, physical or digital models, geographical representations, videos etc.), when interpolated with public data and cartographies that deal with risk in a scientific way, give back an overall picture that lays the foundations for effective forms of architectural design.

The second approach, the participatory one, is related to achieving antifragile conditions and educating communities to a state of preparedness. It starts from studies on participation and its possible models – «scaling» (Arnstein, 1969), «wheeling» (Davidson, 1998, 15), and «targeting» (Ciaffi & Mela, 2011) – identifying the possible positions of a participatory process in its elitist, organicistic, pluralistic, conflictual, and antagonistic conceptions (Ciaffi & Mela, 2011) and investigating the different social dimensions involved: communication, animation, consultation, and empowerment. The shift from the sociology and philosophy of participation to an «architecture of participation» (De Carlo, 1972) occurs by applying these models to the sphere of space: the identification of the possible stakeholders – architect, client, user, general public – and their roles – informing, consulting, deciding – in all the stages of the architectural project – design, construction, post-completion – allow us to define the real level of participation within a process (Jenkins & Forsyth, 2010). Co-design, the most complete stage of participation, is achieved when the possible actions of the actors are given a co-creative dimension, in the direction of collaboration.

These two approaches are accompanied by an ethnographic sensibility linked to anthropology, a discipline that can be considered very relevant in co-design activities, combining both spatial and social dimensions.

> *«Il sapere antropologico, cioè il sapere specialistico con il quale l'architetto giunge sul campo, deve essere messo in crisi dall'attività etnografica. Se al termine del lavoro sul campo le convinzioni disciplinari dell'architetto risulteranno immutate, la pratica etnografica sarà stata inutile: non si sarà imparato nulla. Se invece qualcosa si sarà imparato, allora l'approccio antropologico avrà centrato anche il secondo obbiettivo:*

avrà individuato cosa tradurre. E questo cosa, nella nostra fattispecie, è la manipolazione dello spazio» (Bilò, 2019, 146)[14].

Co-design Approaches: The Possibilities for a Strategy

The application of the proposed methodology passes from the translation of the participatory models identified in the literature review into co-design actions. It is worth combining them with some possible approaches to the architectural project identifiable through the study of design processes within some best practices. These are the classical, self-deterministic, appropriative, pedagogical, and ethnographic approaches.

Classical Approach

It is the first and most widespread approach, easily traceable in past and contemporary experiences as a legacy of the mentioned 1970s ideological matrix. The classical approach is based on moments of confrontation in which the users are considered as active participants in the project choices: this is a widespread practice present in any project that proposes a participative methodology.

Self-deterministic Approach

This concerns the first forms of co-creation that occurred in vernacular architecture, with practices of self-construction and rituals. In chronological order, the self-deterministic approach can be considered the first one appeared in the building culture.

Appropriative Approach

The personalization of space by users is a widespread practice in contemporary architecture. An appropriative approach directs the designer's gaze towards the needs of the communities, especially in at-risk contexts and post-disaster temporalities.

Pedagogical Approach

Within this approach, the architect's task is to empower people through participatory practices increasing awareness towards the built environment and community cohesion. It considers architectural design as a process to build knowledge and to reach a common education. In these terms, a pedagogical approach to co-

14. «Anthropological knowledge, that is, the specialized knowledge with which the architect arrives in the field, must be challenged by ethnographic activity. If at the end of the fieldwork the architect's disciplinary beliefs are unchanged, the ethnographic practice will have been useless: nothing will have been learned. If, on the other hand, something will have been learned, then the anthropological approach will also have hit the second goal: it will have identified what to translate. And that what, in our case, is the manipulation of space» (Bilò, 2019, 146) (English translation by the author).

design sees spatial education as one of the aims of participatory transformations in contexts subject to risk and uncertainty.

Ethnographic Approach

The physical dimension of architecture can be combined with the social dimension of communities, with the awareness that the identity of man presupposes the identity of place and *vice versa*. An ethnographic approach implemented through on-field work, allows designers to adopt a vision that relates people and space assuming an anthropological register in addition to a figurative one.

Co-design Tools: Tactics

Some co-design tools can be associated with the identified approaches, considered as moments in which the participation of the communities becomes transformative. Examples of them are meetings, interviews, focus groups, workshops, incremental design, self-construction, and co-living. Thus, a double register of strategy and tactics is proposed by this kind of research. The former, constituted by the co-design approaches, is understood as a processual and dynamic type of project idea, which involves a comprehensive view of issues in their complexity, proceeding by methodological principles oriented to generate new conditions. The latter, on the other hand, are represented by co-design tools, specific actions understood as bottom-up practices, free from traditional procedural and institutional systems.

Proposing an overcoming of the separation between strategy and tactics, a new model is proposed in which approaches and tools are considered interdependent. They create a system of constructing, reading, and interpreting complex relationships, that is architectural co-design. The outcome of this reflection on theories and practices will be a toolkit of effective and accessible actions, exploring the relationships between common spatial education and the possibilities of risk adaptation, prevention, and mitigation. For its effective formulation, a test of the methodology is proposed on a real context, with an inductive research process (Figure 8) and an orientation from the particular case to the general register, identifying iterable co-design actions.

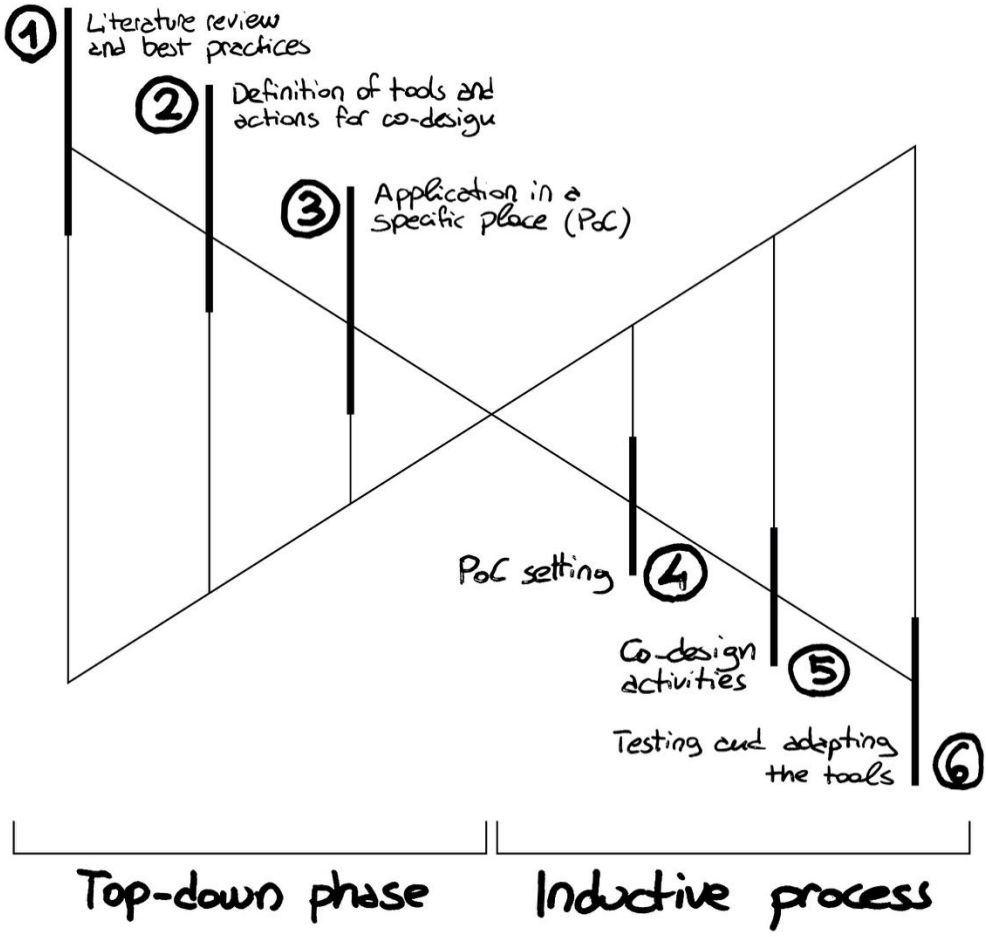

Figure 8. *Diagram of the Inductive Research Process*
Source: Graphic work by the author based on a diagram by Stefano Sartorio.

Proof of Concept: Lomellina, an Italian Fragile Region

The proof of concept (PoC) illustrated in this paper comes from design-driven research for the study of safe spaces in Lomellina region, an Italian inner area[15] between the province of Pavia and the Piedmont border, on the banks of the Po and Sesia rivers, irrigated by the Agogna river and numerous man-made agricultural canals. It is subject to a plurality of natural risks that determine its high territorial complexity (Figure 9).

15. The Lomellina region has been identified as one of the 8 regional inner areas within the *Strategia Nazionale Aree Interne SNAI* by *Regione Lombardia* in 2021.

Figure 9. *A Typical Settlement in Lomellina Region: Buildings exposed to Hydrological Risk*
Source: Photo by the author, 2024.

Lomellina is a region which is experiencing demographic decline and pronounced population aging. Its urban pattern is dominated by "small" municipalities with fewer than 5000 residents, and many "very small" ones with under 1000 of them. Although modest in population size, these municipalities often have wide territorial boundaries and a polycentric layout: the main settlement or "*capoluogo*" administers numerous villages and rural clusters. The region is mostly agricultural, strongly defined by rice cultivation, yet it is also undergoing the erosion of rural spaces and facing the spatial

consequences of highly specialized, intensive farming practices. Within this context, flood and hydraulic hazards – key components of the broader hydrogeological risk – intersect with the presence of a large, environmentally impactful energy-sector industrial plant. This combination produces a multi-risk environment in which local vulnerabilities are stressed on two levels: climate change accelerates the recurrence of extreme weather events, while the scale and positioning of the ENI refinery buildings introduce an additional layer of industrial risk for nearby settlements[16]. After a study of the context and the specific literature review, 12 municipalities of Lomellina region were chosen to test a set of key concepts elaborated with an inductive methodology for communities' cooperation in DRR, DRM, and CCA design and policy-making processes. These are the settlements closest to the rivers and most affected by hydraulic and industrial risks: Candia Lomellina, Breme, Sartirana Lomellina, Torre Beretti and Castellaro, Frascarolo, Suardi, Gambarana, Pieve del Cairo, Mezzana Bigli, Ferrera Erbognone, Sannazzaro de' Burgondi, and Pieve Albignola.

The PoC setting and testing processes followed some main steps, summarized below in chronological order.

First Phase: Setting a PoC

An analysis of data and cartography focused on risk dimensioning and reading of emergency urban planning documentation (*Piani di Protezione Civile* or PPC, and *Piani di Emergenza Comunale* or PEC) cross-referenced with ordinary planning (*Piani di Governo del Territorio* or PGT)[17] was preliminary to the subsequent on-field work. This phase was devoted to the verification of places considered safe or vulnerable by emergency or ordinary planning, accompanied by a qualitative assessment of their spatiality, whether indoor or open spaces. The output of this first study is the formulation of an atlas of safe and vulnerable places. As explained in the previous paragraph, in the first research methodology step the urban form and the section of settlements is investigated too, in order to spatialize risk and better understand the extent of exposed elements (Figure 10).

16. See *Territorial Profile of Lomellina* https://www.altrelombardie.polimi.it/ (last access: September 2025).

17. Civil Protection Plans, Municipal Emergency Plans, and Territorial Government Plans (English translation by the author).

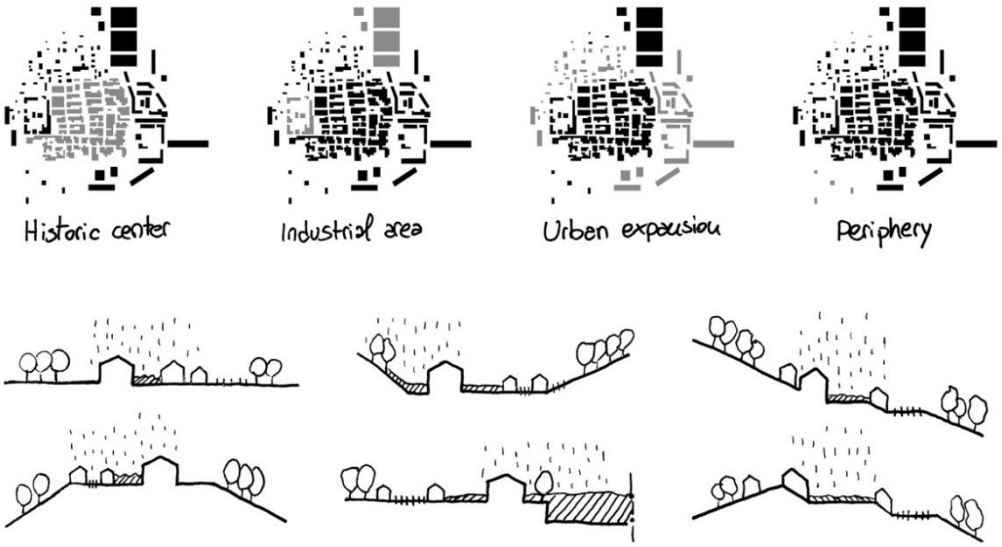

Figure 10. *Relationships between Risk and Urban Morphology*
Source: Graphic work by the author.

A second action of this phase was the definition of a stakeholders' network as a result of on-site visits, followed by the distribution of an online questionnaire as a third action to evaluate the community's perception of risk.

Second Phase: Co-design Activities and Participation

From the second phase of the PoC work, the participatory approach of the research methodology came into play too. Community engagement took place gradually, initially with semi-structured interviews with representatives of municipalities and then involving *Protezione Civile* agencies, local authorities, and associations in a kick-off seminar entitled *Conoscere per prevenire: approcci, metodi e strumenti partecipativi per comunità resilienti al rischio*[18] held in Politecnico di Milano on June 4th-5th, 2024. On this occasion, the research group contacted local actors and key stakeholders, proposing a shared methodology and reasoning on the construction of a common knowledge (Figure 11).

18. *Knowing to prevent: participatory approaches, methods, and tools for risk resilient communities* (English translation by the author).

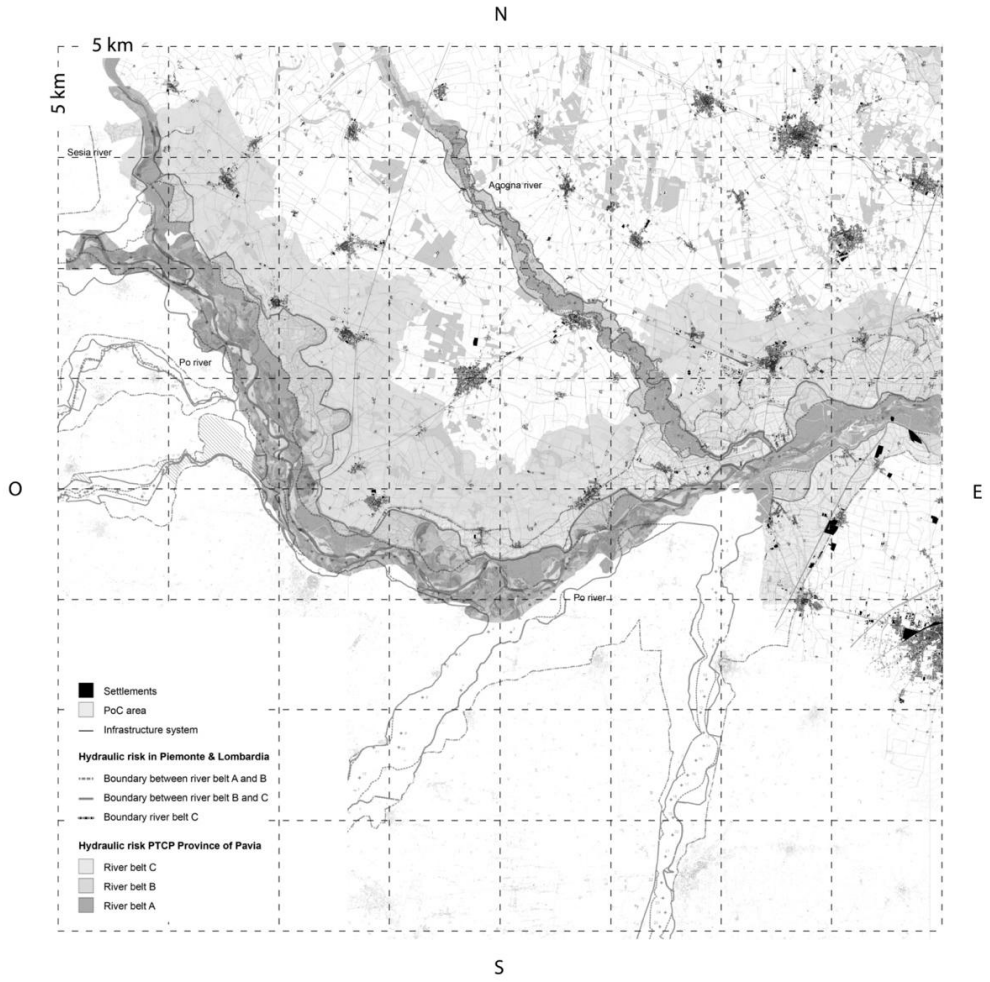

Figure 11. *Setting a PoC: Hydraulic Risk in Lomellina Region*
Source: Graphic work by the author within the RETURN Task 7.4.4 research.

A second action of this phase took place on October 18th, 2024: a focus group with the community at the *Protezione Civile* headquarters in Mede (PV). It is another tool of participation and co-design that has been tested with the PoC work. This moment was dedicated to building shared knowledge too, a community activity of co-mapping of risk issues in Lomellina region (Figure 12) and people consultation. The safe spaces and vulnerable places in the area according to the population were compared with those identified by the emergency and ordinary planning investigated in the first phase of the research. The discrepancy in some of the results obtained was a necessary study element in the development of the next steps: for the municipality of Breme, the population recognized 2 out of 6 safe places, in Sannazzaro de' Burgondi the number was 3 out of 4, and in Candia Lomellina 2 out of 4.

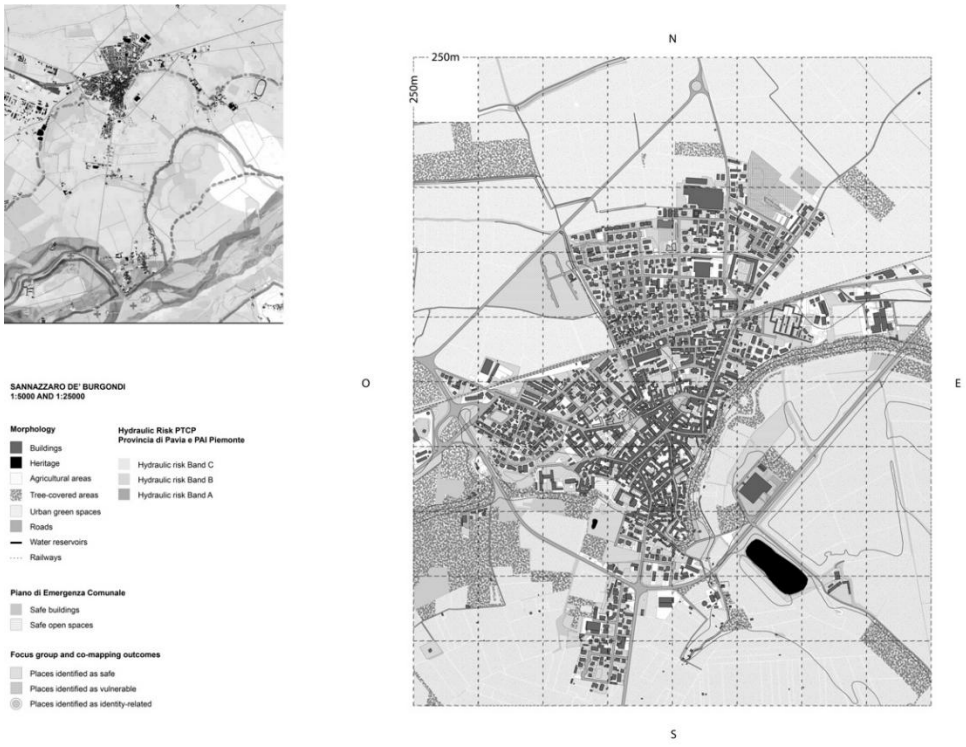

Figure 12. *Output of Co-mapping Process for Sannazzaro de' Burgondi*
Source: Graphic work by the author within the RETURN Task 7.4.4 research.

As a third action, the development of some tools for community engagement within planning for DRR, DRM, and CCA stems from the observations that emerged from the previous phases, especially in comparing participatory processes and on-field activities with studies conducted at the beginning of the research on mapping and planning documents. A first tool is a set of participatory survey forms to evaluate the adequacy of safe places, followed by a second tool consisting in a communication project through images for understanding risk factors, proper use of space, and behaviors to be adopted in case of an emergency. Here, a possible response to the need of a common language among the community has been explored by the research group in a process of learning by doing which involved both specialists and non-experts.

The participatory survey forms were initially shaped through conversations with local stakeholders, then on-field tested with a set of organized exercises and revised whenever necessary. The criticalities and potentialities that emerged from this participatory survey phase later formed the basis of the co-design workshop – the fourth action – held on October 18th, 2025. During the workshop, two working round tables – composed of community representatives, volunteers from *Protezione Civile*, and the research team – addressed the challenges of transforming and adapting safe places, both buildings and open spaces, in the municipality of Sannazzaro de' Burgondi. This collective moment not only laid the foundations for the development of a community-based architectural project but also strengthened the community's awareness and spatial understanding of risk-related issues.

Themes across Time Phases

The research actions identified by the working group are centered on three main themes: prevention and resilience, regeneration, and participation for common education. They are understood to cut across the practical phases of the study, as three conceptual pillars that enable iteration of the process and verification of results. The first one, about prevention and resilience, concerns developing integrated strategies to DRR and DRM, starting with a critical analysis of the spatial structure of settlements and guiding the transition from planning to projects in the definition of safe places. The second theme is about promoting regeneration processes that lead to co-design activities in order to enhance the built environment and open spaces towards risks adaptation. The last one, related to common education and participation, is aimed to strengthen community awareness and build a shared knowledge between users, specialists, clients, and the general public to enhance DRR, DRM, and CCA (Corradi, 2025).

Although the research is still a work in progress, the initial stages allowed the direction of future ones: reasoning about people's perceptions of the relationships between risk and territory, the shared study of PPC-PEC, and the identification of identity places and areas considered safe by those who live there, have instructed a co-design-driven research methodology with an interesting bottom-up orientation, whose next steps concern an accurate understanding and re-reading in a design key of that spaces. The goal is adaptation to risk and preparedness to uncertainty through a process of spatial co-learning that participatory actions and co-design take on, to reach antifragile conditions.

Results and Discussion of the Proof of Concept

The research uses an inductive methodology based on triangulation between cartographic analysis, ethnographic observation, and participatory verification. The impact of participatory activities is then assessed through the convergence or divergence between technical planning and community perceptions, iteratively testing tools, processes, and results. The work on the PoC, conducted in the vein of the three conceptual pillars identified and according to the above-mentioned phases, made it possible to formulate some observations. They are reported below in chronological order, trying to link each of them to the subsequent moments of the research, which was always developed by adapting and questioning the methodology and tools used according to the results.

Among the PoC municipalities in Lomellina region, only 3 of them have a PPC or PEC published online: while the adoption rate of PPCs and PECs in the Lombardy region is 78%, it drops to around 40% in the province of Pavia (Dipartimento della Protezione Civile, 2022). Therefore, based on the online accessibility of PPC and former PEC which represents an important datum itself, the analysis of planning tools has been conducted in Breme, Candia Lomellina, and Sannazzaro de' Burgondi.

The first step of this comparative analysis was the elaboration of thematic territorial maps, which illustrate the locations mentioned in the above-listed

documents for each municipality in the PoC, to set a shift from the urban to the architectural scale. Although there was a correspondence between locations classified as safe by PGTs and those identified in the PECs or PPCs, some discrepancies emerged from the focus group results: despite the strong alignment in official planning documents, most of the spaces classified as safe by them were never mentioned during the consultation. This suggests a gap between technical assessments and community perceptions, enlightening the need for an effective integrated approach in planning and design strategies. In light of these observations, the next phases of the research will focus on the following outcomes: a toolkit for participatory actions and operational guidelines for integrated DRR, DRM and CCA, based on co-design, which can be replicated in other contexts.

To address the misalignments between the common sense and the specialized knowledge mentioned above, the research group developed a set of participatory survey forms to assess the adequacy of safe places, which is defined as the ability of buildings and open spaces to work effectively as safe areas in emergency scenarios during a disaster. The developing method for the tool consists of 5 steps: (1) a draft of the survey forms; (2) an on-field testing by the research group; (3) a revision of the survey forms; (4) other tests by municipal technicians; and (5) the final versions production of the survey forms. Considering the contents of the PECs and PPCs, two survey forms were developed: one for buildings and one for open spaces. The main references for the tool's structure and contents were the AEDES post-earthquake damage and habitability assessment forms and guidelines for identifying operational coordination centers (*Centri Operativi di Coordinamento* or COC) and emergency areas, both realized by the *Dipartimento di Protezione Civile*. After three on-field tests by both research group (2) and municipal technicians (4), and after the revision of the contents according to the arisen issues, the next step will be to develop a simple version of the forms, providing it to the entire communities and asking them to conduct on-field tests to gather feedback. Because although the used tools are proven to be effective, the research acknowledges certain limitations: the need for simplification, the difficulties of transferring complex methods to small communities, and the dependence on voluntary engagement. Replicability of them, which is one of the aims of the study, may requires contextual adaptations.

As seen in the phases' explanation, the research continued by investigating the spatial awareness and common education of residents in the form of a graphic representation of images to communicate danger, safe spaces, appropriate behaviors in the event of a disaster or emergency, and the potential transformation of open spaces and safe places (Figure 13). The graphics used in these drawings were designed to be accessible and easily interpreted even by non-experts, obtained as a result of a study on language sharing. In this passage, adopting a place-based and bottom-up approach, and focusing on the *ex-ante* temporalities of risk, the research group echoed the work of architects as Yasmeen Lari, Atelier Bow-Wow, Shigeru Ban, and others who engaged communities by fostering an understanding of the built environment as a preparatory step towards the appropriate use or transformation of safe spaces.

Finally, the results of the PoC show how shared mapping, focus groups, and participatory surveys have generated forms of collective awareness and spatial

common education, activating those processes of adaptability that are associated in the premises with the notion of antifragility. The transformation of knowledge – from technical to shared – becomes here a theoretically fundamental mechanism.

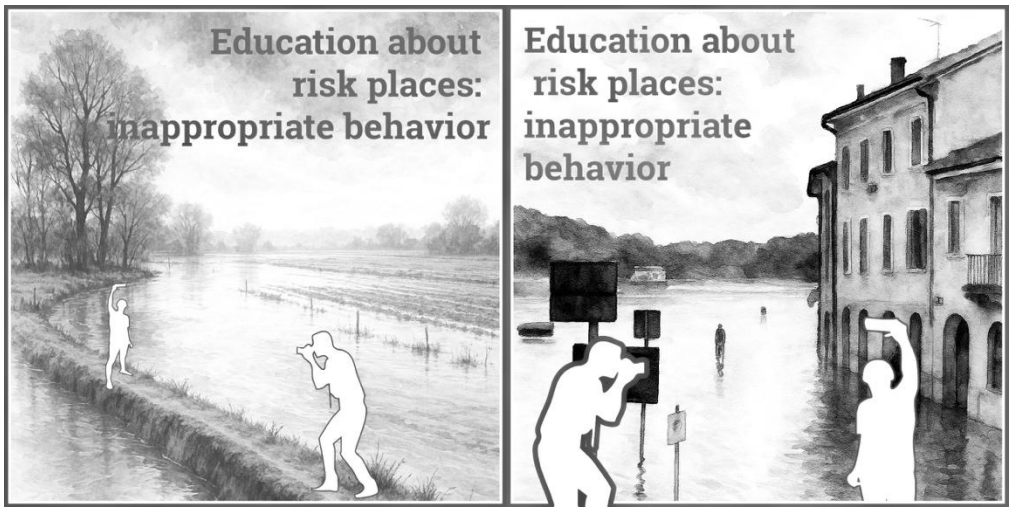

Figure 13. *Output of Common Education Process*
Source: Graphic work by Stefano Sartorio within the RETURN Task 7.4.4 research.

Conclusions as Openings

At this point, as a contribution towards new forms of knowledge, it is necessary to expand the discussion in relation to the bottom-up orientation chosen in the proposed co-design-driven research methodology. As seen before, too often in contemporary times, exclusively *ex-post* approaches have been adopted towards natural disasters: the top-down directionality of the reconstruction processes and the failures in DRR and DRM have demonstrated the ineffectiveness of traditional operations and the need of adaptation to – rather than a contrast of – risk. This is especially evident in Italy, where there is a lack of adequate policies to enable the activation of actions directed towards prevention. As in the History of Architecture the hegemony of a certain architectural culture has been fronted with new urban models – understood not so much as ideal worlds to strive for, but as concrete forms of spatial and social renewal –, today we need to address the permacrisis condition of risk society that results in the uncertainty of space. Participatory architecture and co-design are the vehicle for this necessary updating, looking to domestic utopias (Kroll, 1996), realistic utopias (De Carlo, 1972), and realizable utopias (Friedman, 1974) as cultural environments for the development of broad visions. Moreover, this desired paradigm shift requires a holistic and systemic approach, with a view to adapting disciplinary thinking towards the complexity of reality. Since risk, uncertainty, and design are, as we tried to discuss in the opening of this contribution, deeply related concepts, a revision of the cultural apparatuses of the knowledge involved in the transformation of space is needed (Galderisi, 2020). Architecture must therefore be the working matter of an adapted complex spatial thinking.

> *«Une pensée qui isole et sépare devrait être remplacée par une pensée qui distingue et unit. A la pensée disjonctive et réductrice devrait être remplacée une pensée du complexe au sens originel du terme complexus: ce qui tient ensemble»* (Morin, 1999, 91)[19].

A community-based approach oriented to architectural co-design is essential in the discussed multi-risk scenarios, since the relationships between social groups and their physical environment do not occur according to linear biunivocal processes (De Carlo, 1972). Here, processes of «sharing and commoning» (Belfield & Petrescu, 2024) would not only help to achieve a more equitable antifragility but also lay the foundation for the formation of risk awareness within the built environment through spatial common education of people. Actually, that of awareness-education is one of the possible contemporary interpretations of participation, along with empowerment and creative collaboration (Gangemi, 2019). These are all modalities that presuppose a transformative approach and pave the way for a collaborative creativity capable of challenging the hierarchical and consumerist structure of capitalist society through a shared production that is linked to the capacity of communities to aspire (Appadurai, 2011).

In summary, in defining the relevance of work for future developments, the paper contributes to reframe architectural co-design as a strategic *ex-ante* action against risk. By bringing together traditionally separate bodies of literature – community-based architectural practices and DRR, DRM, and CCA – the research advances a co-design-driven methodology explicitly calibrated for multi-risk and permacrisis conditions. The study further innovates by co-constructing this methodology with an inductive process in a real territorial context, the Lomellina region, demonstrating how participatory tools can realign expert assessments with community perceptions of vulnerability and safety. Through the articulation of iterable and adaptable co-design moments or tactics (Figure 14), the work expands the disciplinary understanding of how architecture can foster antifragility and preparedness through bottom-up processes.

19. «Thinking that isolates and separates should be replaced by thinking that distinguishes and unites. Disjunctive and reductive thinking should be replaced by complex thinking in the original sense of the word complexus: that which holds together.» (Morin, 1999, 91) (English translation by the author).

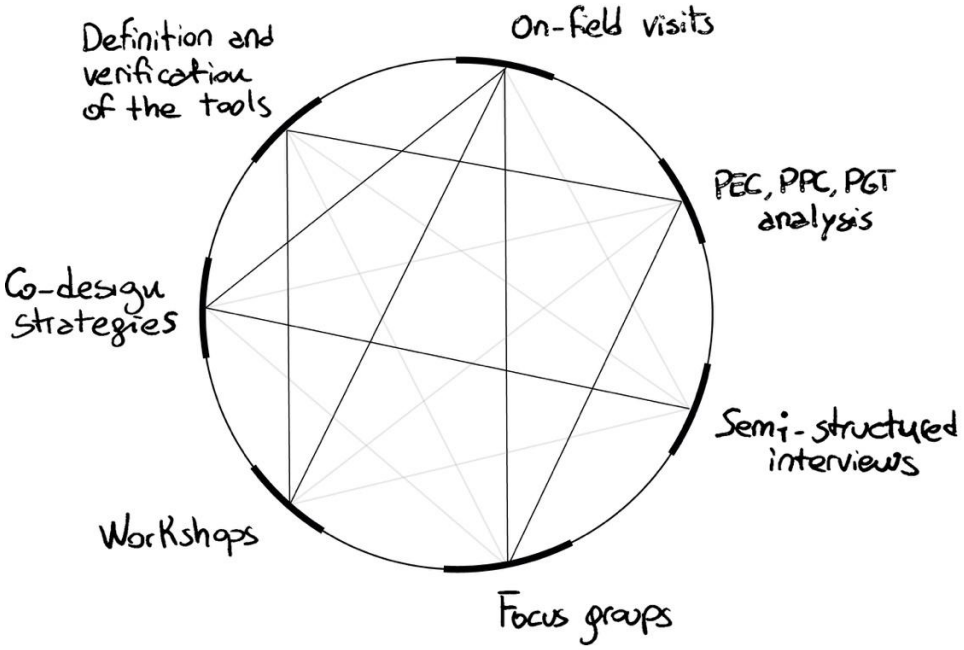

Figure 14. *Process Iterability Diagram*
Source: Graphic work by the author.

All this critical spatial thinking, as we have seen, is included and used in the formulation of a research methodology applied to architectural design that is highly adaptable to the complexity of different social and territorial contexts. This positions architectural co-design not simply as a participatory choice, but as a necessary epistemic shift for spatial disciplines operating within the uncertainties of the contemporary risk society. However, to imagine it as sensitive to contemporary issues, it is necessary to rethink architectural co-design outside of traditional schemes (Navarra, 2017), defining possible new horizons of research and re-shaping the role of the architect as a real member of the community, as a user of a shared uncertain space, and as a specialist of risk – not in a scientific sense but in his capability of building shared knowledge around it, engaging and empowering the rest of community.

> *«Quanto a noi (perché anche noi siamo investiti dall'onda dell'esplosione di rifiuto), cominciamo ad avere il dubbio che il nostro ruolo, oltre a essere precario, è anche ambiguo e che forse occorre revisionare il modo di fare architettura per restituire legittimità a noi stessi e all'architettura. Possiamo allora dire che siamo pronti a cambiare direzione? Forse possiamo dire soltanto che la nuova direzione è aperta e che rappresenta una concreta alternativa, nel presente»* (De Carlo, 1972)[20].

20. «As for us (because we, too, are hit by the wave of the explosion of rejection), we are beginning to have doubts that our role, besides being precarious, is also ambiguous and that perhaps we need to overhaul the way we do architecture in order to restore legitimacy to ourselves and to architecture. Can we then say that we are ready to change direction? Perhaps we can only say that the new direction is open and that it represents a concrete alternative, in the present» (De Carlo, 1972, 67) (English translation by the author).

Figure 15. *Lomellina Rural Areas*
Source: Photo by the author, 2024.

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