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D2.2 – Engagement strategy report with a roadmap for addressing current and future needs in vulnerable areas

Deliverable summary

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Executive summary

The deliverable D.2. *Engagement strategy report with a roadmap for addressing current and future needs in vulnerable areas* outlines key insights from the workshops held with RETIME Work Package Leaders (WPs), Task Leaders (TLs), and Local Desk Members (LDMs) during the first year of this project. These workshops aim to contribute to the development of a comprehensive multi-actor engagement strategy and social innovation roadmap. This includes local promotional raise-awareness campaigns and co-design of RETIME solutions designed for: i) Information Visualisation of disaster risk; ii) Physical solutions to risks; iii) Digital solutions to risks; and iv) Alert and monitoring systems.

D2.2 outlines the key features and characteristics of stakeholder engagement in Disaster Risk Reduction (DRR) and in resilience frameworks, aiming to develop a model that can be tailored to meet real-life needs, values, and expectations of target groups (local stakeholders and end-users of project solutions/technologies), across the three RETIME pilot sites.

By adopting and adapting DRR frameworks through validation workshops with project partners, this report defines a social innovation roadmap for each pilot site. Such a roadmap details the objectives of each engagement activity, the end-users, and other critical stakeholders to be involved, the specific tools and methods, the format (full online, hybrid, offline), and the timing for the implementation. This report also includes a framework for the post-assessment of the performance of each engagement and co-design activity, measured through a set of quali-quantitative social Key Indicator Performances, such as number of participants, gender, type of target group, and level of engagement.

This report is intended for local vulnerable groups, building users, owners, managers in the three pilot areas, policy- and-decision-makers, and members of RETIME and other EU sister projects.

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List of acronyms and abbreviations

AR	Augmented Reality
BIM	Building Information Modeling
CA	Consortium Agreement
CBSS	Council of the Baltic Sea States
CDE	Communication, Dissemination, Exploitation
CDR	Community Disaster Resilience
CML	Câmara Municipal de Lisboa I Lisbon City Council
DBRP	Digital Building Renovation Passport
DCT	Data Collection Template
DIDRR	Disability Inclusive Disaster Risk Reduction
DRM	Design Risk Management
DRR	Disaster Risk Reduction
DSS	Decision Support System
DT	Design Thinking
EC	European Commission
FEMA	Federal Emergency Management Agency
GIS	Geographic Information System
HCD	Human Centred Design
ICT	Information and Communication Technology
IJDRR	International Journal of Disaster Risk Science
KPI	Key Performance Indicator
KTA	Knowledge-to-Action
LCD	Local Communication Desk
LDM	Local Desk Member
NEB	New European Bauhaus
PIM	Power-Interest Matrix
PPRR	Prevention-Preparedness-Response-Recovery
RAF	Resilience Assessment Framework
SEOF	Stakeholder Engagement Options Framework
SFDRR	Sendai Framework for Disaster Risk Reduction
SME	Small and Medium Enterprise
TL	Task Leader
UCD	User-Centred Design
UD	Universal Design
UNDRR	United Nations Disaster Risk Reduction
VR	Virtual Reality
VIPP	Visualisation in Participatory Programmes
WPL	Work Package Leader

1. Introduction

The deliverable D.2. *Engagement strategy report with a roadmap for addressing current and future needs in vulnerable areas* describes the stakeholder engagement and co-design strategies developed within the project RETIME, providing a social innovation roadmap to help RETIME Beneficiaries develop an engagement strategy that includes all key stakeholders and end-users in the co-design of project solutions. This roadmap has been designed by organising internal workshops with the consortium Work Package Leaders (WPLs), Task Leaders (TLs), and Local Desk Members (LDMs) during the first year of the RETIME project.

This report defines a multi-actor engagement strategy during the project lifetime designed for:

- Local promotional raise-awareness campaigns
- Information Visualisation of risks
- Physical solutions to risks
- Digital solutions to risks
- Alert and monitoring systems

Engagement strategies will be implemented at pilot level (Lisbon, Žilina, and Tartu) throughout the project by engaging stakeholder in different activities and through different methods.

This deliverable also includes the post-evaluation framework for measuring the performance of each engagement and co-design activity by including a Data Collection Template (DCT) containing Key Performance Indicators (KPIs). The DCT will allow RETIME Beneficiaries to monitor the effectiveness of stakeholder engagement strategies within the co-design activity of the RETIME project and adapt them, if necessary, throughout the project's duration.

Besides its *Introduction*, this report is composed of five sections. *Section 2* presents an overview of Disaster Risk Reduction (DRR) frameworks, useful to identify potential strategies for engaging people across the phases of the Emergency Management Life Cycle (prevention/mitigation, preparedness, response, recovery – hereafter referred to as PPRR). *Section 3* aims to align RETIME project outputs and outcomes with the Sendai Framework for Disaster Risk Reduction (SFDRR). *Section 4* shows the main findings and insights from the internal workshops to understand the main needs of key stakeholders in defining the RETIME solutions, while guaranteeing the model scalability on municipal and national levels. This section offers a preliminary social innovation roadmap. *Section 5* identifies specific remarks and next steps for implementing the co-design strategy. Figure 1 outlines the contents of this deliverable.

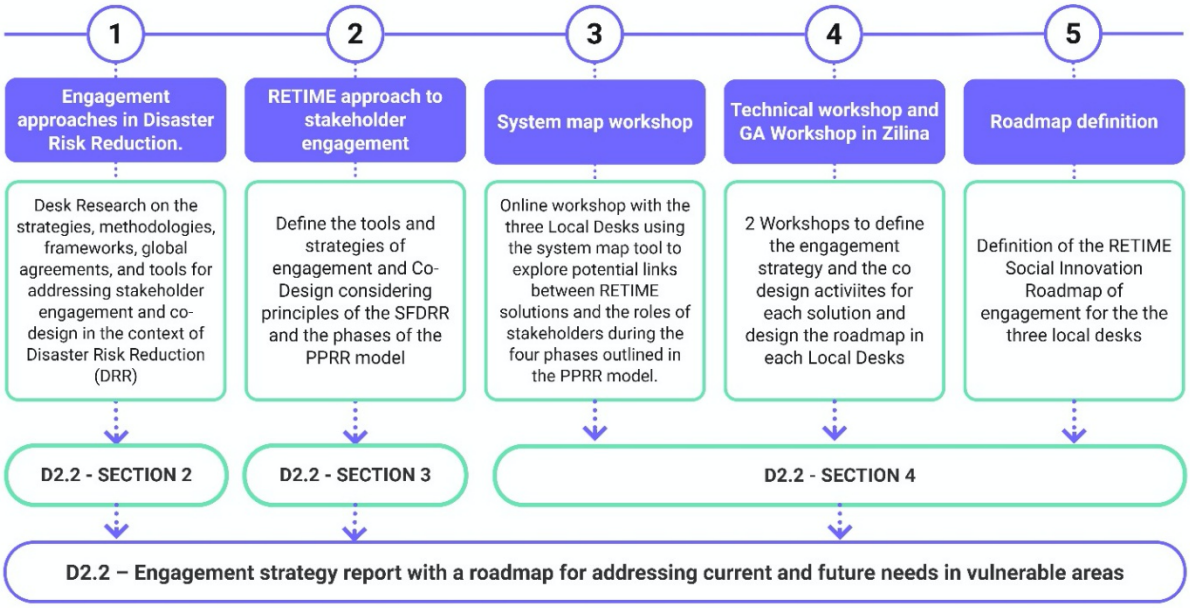


Figure 1. Outline of the deliverable D2.2.

1.1. Main topics and RETIME interrelated deliverables

This deliverable relates to the following RETIME specific topics and deliverables (Figure 2):

- ***Analysis of status and opportunities within the regulatory framework and related initiatives*** in RETIME pilot sites, detailed in *D1.2 - Report on existing long-term resilience visions and adaptation solutions in the pilot areas*.
- ***User interfaces of RETIME solutions to enable accurate object-related digital information exchange***, specifically addressing the needs of the key stakeholders and end-users of the tools and integrated services developed within the project, defined in *D1.3 - Report on data specification requirements framework Part 1* and *D1.5. Report on data specification requirements framework Part 2*.
- ***Stakeholder mapping analysis***, addressed in *D2.1 - Stakeholders Map with profiles, social survey analysis, and defined roles*.
- ***Ethics, privacy, and participant rights compliance***, as identified in *D7.2 - Quality Plan*, with a focus on diversity, inclusion, gender mainstreaming, and intersectionality throughout RETIME stakeholder engagement processes, and in *D7.4 - Data Management Plan*.

The main outputs of this report will be used throughout the project, especially for the refinement and implementation of RETIME engagement strategy outlined in *D2.3 - RETIME Stakeholder*

engagement strategy (WP2/T2.3) as well as for the co-design of specific solutions, as identified in the Grant Agreement (GA):

- *sustainable business models* considering all actors in the value chain from design over construction to end of life (WP1/T1.4)
- *site-specific emergency protocols* to improve safety and resilience also considering the perspectives of buildings' occupants (WP4/T4.1)
- *requirements for the Digital Building Renovation Passport (DBRP) tool* and co-design of the different interfaces (WP4/T4.5)
- *Resilience Knowledge Hub and Decision Support platform* also leveraging citizens' science (WP4/T4.6)
- *e-learning resources:* Infrastructure Resilience Ideathons and awareness game (WP6/T6.3)

The activities within WP2/T2.2 aim to foster co-design of local promotional campaigns to increase the awareness of building occupants, building owners and managers, as well as other stakeholders in public and private sectors on the available solutions in case of extreme climatic events and other hazards. These co-designed promotional campaigns will be run through Local Communication Desks (LCDs) and then transferred into European-wide campaigns to enhance the overall outreach of the communication and dissemination activities (as planned in WP6).

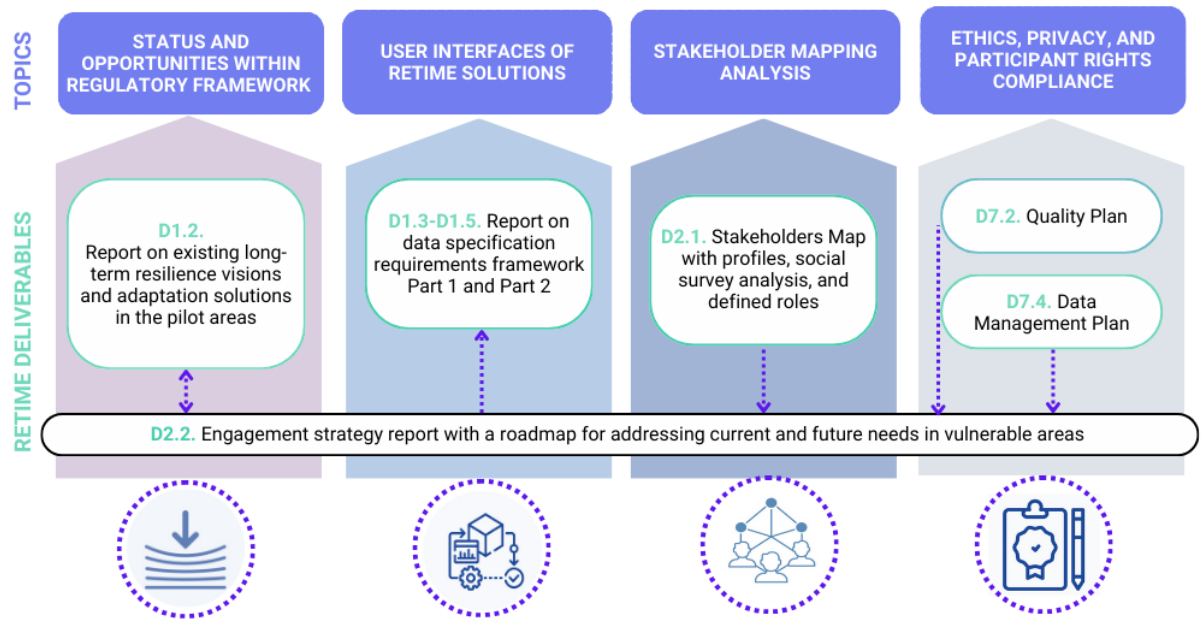


Figure 2. Main topics of this deliverable (D2.2) and other RETIME interrelated deliverables.

1.2. Challenges and limitations

Community-oriented approaches are essential in climate risk management, although co-design and stakeholder engagement present several challenges. While unequal background of involved people, conflicting interests among various target groups, and differing interpretations of risk are common challenges in risk management,[1] the key challenges faced in RETIME are specifically related to time and resource constraints and managing stakeholder expectations throughout the project's lifespan and beyond.

To overcome time and resource constraints, aligning engagement activities with other project tasks (such as the second RETIME General Assembly meeting on April 2025 - M12, held at Žilina, Slovakia) helped save time and broaden participation. To address the challenge of managing stakeholder expectations over the four-year duration of the project, RETIME Beneficiaries are actively collaborating (and will continue to do so) with representatives of civil and political authorities in the three pilot areas and across Europe. This ongoing collaboration, even beyond the project's conclusion, will support initiatives aligned with RETIME values and principles. Follow-up activities will also ensure the long-term validation and management of collected data.

Research on co-design frameworks highlighted that involving stakeholders and end-users in the development of technological solutions can enhance outcomes in terms of solution acceptance and long-term success. By incorporating social, behavioural, and usability dimensions, co-design ensures that solutions are more aligned with real-world needs and contexts. This is relevant in the RETIME project although engaging local and specific vulnerable target groups across the three pilot sites is challenging for different reasons. First, in the RETIME pilot sites, vulnerable groups rarely participate in co-design activities or are only partially engaged in initiatives that focus on more immediate concerns, such as safety and community support, rather than climate-related risks. Second, engaging diverse target groups, many of whom have specific needs or are experiencing temporary or long-term vulnerability, is a process that requires sensitivity and time to be carried out effectively. Third, it can be challenging to keep local stakeholders motivated when the benefits of their involvement are long-term or not immediately apparent. To engage local stakeholders properly, the collaborative and ongoing involvement of RETIME Beneficiaries and other members of their local networks is crucial. This report aims at guiding and supporting them with actionable tools. Providing training to key actors (local desk

[1] See e.g., Granderson (2014)

members as well as decision-makers, IT suppliers, and designers of the solutions) across the three pilot sites will enable them to facilitate or co-lead engagement sessions.

2. Engagement approaches in Disaster Risk Reduction

This section reports a brief overview of the methodological frameworks, global agreements, principles, and tools for addressing stakeholder engagement and co-design in the context of Disaster Risk Reduction (DRR). An analysis of relevant frameworks and strategies were conducted based on scientific publications and articles in leading thematic journals, and by analysing models defined within global agreements, such as the United Nations Disaster Risk Reduction (UNDRR) Sendai Framework.

Overall, of 25 documents published between 2015 and 2025 were selected and analysed: 16 were sourced through a combination of scientific thematic journals such as *International Journal of Disaster Risk Reduction,*[2] *Progress in Disaster Science*,[3] and *International Journal of Disaster Risk Science,*[4] alongside searches conducted via Google Scholar, while for remaining 9, a snowball technique was used,[5] including sources on global agreements and government reports as national plans and national acts. The search was restricted to results in English language and published in the last 10 years (2015-2025), using the following keywords: *'Stakeholder engagement', 'Disaster Risk Reduction', 'Disaster resilience management', 'Engagement Roadmap', 'Inclusive Roadmap', 'Universal Design methodologies', 'Participatory methodologies', 'Emergency Risk management'; 'Emergency Preparedness', 'User-Centred Design', 'Inclusive Design'*.

This section is organised as follows. *Section 2.1* focuses on how Universal Design approach can help to adapt crisis management models to stakeholder engagement by considering the needs of vulnerable groups. *Section 2.2* introduces the UNDRR Sendai Framework, an international agreement that defines priorities and objectives to build resilience in communities. *Section 2.3* describes the basics of the PPRR model, one of the most widely recognised Emergency Management models. *Section 2.4* analyses other relevant frameworks that can be useful for the definition of the RETIME stakeholder engagement approach.

[2] https://www.sciencedirect.com/journal/international-journal-of-disaster-risk-reduction
[3] https://www.sciencedirect.com/journal/progress-in-disaster-science
[4] https://link.springer.com/journal/13753
[5] Wohlin et al. (2022)

2.1. Universal Design principles for inclusive design

Universal Design (UD) principles and inclusive design approaches are essential in creating adaptable, accessible, and user-centred solutions for resilience and risk management. According to Mace (1985), it is an approach that allows the creation of products and architectural spaces that are accessible to all people without the necessity of adapting them for a specific target group. The Centre of Universal Design, guided by Mace in 1997, defined the following seven UD principles:

i) equitable use,
ii) flexibility in use,
iii) simple and intuitive use,
iv) perceptible information,
v) tolerance for error,
vi) low physical effort, and
vii) size and space for approach and use (Connell et al., 1997).

Various frameworks have been analysed in the literature to date on accessibility, usability, and inclusivity, ensuring that disaster management tools and systems are tailored to the needs of diverse populations, including people with disabilities, the elderly, and other vulnerable groups. By integrating UD principles, resilience strategies can better address physical, cognitive, and situational challenges that individuals may face during a crisis. Gjøsæter et al. (2020) explored the use of UD in designing ICT (Information and Communication Technology) tools for emergency management, highlighting how accessible ICT systems benefit not only individuals with disabilities but also others facing temporary or situational impairments, such as first responders dealing with smoke or noise.

This approach is highly relevant in RETIME co-design and co-creation activities, as different vulnerable groups have been identified for the deployment of the different planned solutions. Working with these vulnerable groups means to get prepared to adapt engagement activities, workshops and tools to their specific needs, characteristics, and abilities to gather meaningful feedback for improving resilience of the buildings they live in.

2.2. The Sendai Framework

The Sendai Framework for Disaster Risk Reduction (SFDRR, 2015-2030)[6] is a high-level framework that defines the objectives and priorities to prevent all types of disasters and build resilience in communities, countries, and the environment. It identifies four priorities:

i) Understanding disaster risk;
ii) Strengthening disaster risk governance to manage disaster risk;
iii) Investing in disaster risk reduction for resilience; and
iv) Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation, and reconstruction (UNDRR, 2015, p. 14).

Building on Universal Design approach (introduced in *Section 2.1*), the SFDRR emphasises the importance of incorporating UD principles into current risk reduction strategy plans, advocating for accessibility and non-discriminatory participation as essential elements of effective disaster management (Stough & Kang, 2015).

Indeed, one of the main objectives of the SFDRR is to ensure inclusive participation, as DRR strategies involve diverse groups, including people with disabilities and marginalised communities. In this context, non-discriminatory policies must integrate gender, cultural and disability perspectives.

The European Commission played a key role in promoting and supporting the EU Member States to achieve the Sendai priorities, publishing in June 2016, an action plan to guide the implementation of the Framework in EU policies. Different countries have used the framework to design effective Disaster and Resilience Strategies at national level. Multi-stakeholder engagement was essential to meet the priorities of the Sendai framework.[7]

In the frame of RETIME, considering the countries in which the pilots will be carried out, Portugal, Estonia and Slovakia have adapted the framework to the local context:

- In Portugal, the SFDRR serves as a guideline for the Lisbon Resilience Action Plan (2020),[8] which included the implementation of a resilience assessment using the Resilience Assessment Framework (RAF) based on the following four key dimensions of

[6] United Nations Office for Disaster Risk Reduction. (2015). *Sendai Framework for Disaster Risk Reduction 2015-2030*. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030

[7] For example, local plans within the Urban Adaptation Plan in Poland were developed in collaboration with authorities, disaster management experts and residents through debates, workshops, and public consultations, with the Ministry coordinating the engagement activities (Goniewicz et al., 2019).

[8] https://toolkit.resccue.eu/

climate resilience: organisational, spatial, functional, and physical (Telhado et al., 2020).

- Slovakia, according to the 2016 meeting in Brussels of the Council of the European Union (2016), identified the goals of the SFDRR as key guidelines, particularly regarding the resilience of critical infrastructure, and provide concrete recommendations, especially for responding to sudden floods consequences in the energy, transport, and ICT sectors. Slovakia aims to strengthen risk management and response planning by identifying key intervention points for Civil Protection during hazards events (Michal et al., 2019).
- Estonia, as part of the Council of the Baltic Sea States (CBSS), has been involved in the CASCADE project,[9] adapting the SFDRR as a guideline for national policy on resilience and risk management. Since the SFDRR needs to be tailored to the specific context of the CBSS and its countries, Estonian members conducted a risk assessment during this project to define potential risk scenarios (Jernberg et al., 2019). At the national level, these assessments were useful for updating the Emergency Act,[10] which outlines the categories and risk scenarios, specifying the authorities and stakeholders involved in risk management.

2.3. Prevention, Preparedness, Response, and Recovery model

Stakeholder engagement methodologies in DRR require specific strategies to improve collaboration and promote inclusive and sustainable resilience. Multi-level stakeholder engagement, inclusive communication, and adaptive frameworks are crucial for meeting user needs and understandings the contexts they live in. Based on the principles promoted by the Commonwealth, the Prevention, Preparedness, Response and Recovery (PPRR) model outlined the four phases of disaster management (Crondstedt, 2002).

The PPRR serves as a foundational model for disaster management strategies and has been revised and updated over time. Coppola (2015) updated the PPRR model, emphasising first that the phases of disaster management may overlap rather than follow a strict sequence, and second, highlighting it is a continuous process that spans both before and after a disaster event. Preparedness is distinguished from prevention as it considers the actions taken before a disaster occurs, as stated by Granville et al. (2016). This revised approach was later adopted by the

[9] https://www.cascade-bsr.eu/
[10] https://www.riigiteataja.ee/en/eli/511122019004/consolide

Federal Emergency Management Agency (FEMA, 2024) and incorporated in 2024 into the US National Disaster Recovery Framework.[11]

2.4. Other relevant approaches and models

Effective engagement frameworks use both structured and flexible strategies to ensure resilience and inclusivity in different contexts. In practice, this is done using participatory tools, such as semi-structured interviews, community workshops, and focus groups, which facilitate dialogue and the integration of local knowledge to create resilience plans that reflect community values and capacities as stated in literature (e.g., Ryan et al., 2020; Ronoh, 2016). Ryan et al. (2020) analysed a variety of stakeholder engagement techniques and found workshops and information campaigns to be the most effective. Workshops, especially those involving community mapping or participatory design, proved to be successful in transferring knowledge and encouraging behavioural change, while the success of information campaigns was largely dependent on their relevance and specificity to the disaster. In this context, Ronoh (2016) explored the implementation of inclusive DRR in the Auckland school in New Zealand with children with disabilities. In his study emerged that the involvement of students in activities, such as mapping exercises and survival kits, fostered children's risk awareness and sense of responsibility. To further strengthen these efforts, in addition to community-based workshops, the collaboration with Civil Protection, the Red Cross, and local health authorities is essential to ensure comprehensive DRR plans that address the needs of all students.

To develop a more comprehensive understanding of relevant frameworks and models, an analysis was carried out in this project on other frameworks that align with RETIME objectives. Part of the tools and methods proposed in the analysis of these frameworks and models based on UD principles will be further explored in T2.3 to be eventually included in the roadmap.

Three models were identified in this context, as follows:

- *The community disaster resilience (CDR) framework* is an adaptable framework that supports key community stakeholders in measuring the CDR at local level. It uses systemic approaches, like Systems Thinking and System Dynamics, to engage stakeholders in group model building participatory sessions to co-create resilience assessment tools according to their needs and perspectives (Tariq et al., 2021). The process is divided in four stages:

[11] https://www.fema.gov/emergency-managers/national-preparedness/frameworks/recovery

i) definition of community disaster resilience through the interviews and focus groups to identify community-specific resilience issues;
ii) identification of dimensions and indicators from a library covering six resilience dimensions to measure the community-level resilience: physical, health, economic, environmental, social and governance;
iii) development of a community capacity assessment tool. Key stakeholders co-create tools to measure critical resilience dimensions; and
iv) validation and refinement by systems thinking or simulation models for iterative improvements in validation workshops.

This model is useful to compare the methodology developed in RETIME for the Social Vulnerability Index (D2.1) with other methodologies that adopted focus groups and interviews to design indexes and resilience dimensions. This is relevant for the priority (i) identified within the SFDRR.

- *The Disability Inclusive Disaster Risk Reduction (DIDRR) based on KTA (Knowledge To Action)*. This model is based on a participatory and inclusive process involving various stakeholders of the community, including people with disabilities, community and disability support services, and the local disaster management, over several years. These stakeholders can co-design products that can support personalised emergency plans, helping to remove barriers and improve their safety and well-being. The DIDRR is aligned with the requirements defined in the Sendai Framework, which aims to ensure equal access to emergency information and preparedness programs by involving people with disabilities. The KTA framework supports the iterative cycles of data collection, strategy development, implementation, and evaluation (Villeneuve et al., 2021). It provides a structured approach for making change that moves knowledge into practice. The application of the KTA cycles contributes to the DIDRR for achieving three objectives:
  i) identify scope and direction for emergency managers;
  ii) define roles and refine responsibilities; and
  iii) build cross-sector mechanisms for shared responsibility.
  The KTA fosters capacity development and the co-creation of inclusive tools for vulnerable groups. This highlights how cross-sectoral collaboration is essential for developing accessible and effective emergency preparedness plans and tools that benefit the entire community. DIDDR can guide people with special needs or disabilities and service providers to co-create emergency preparedness plans, providing a roadmap of practices through joint development of roles, responsibilities, and resources.

The second model can be used to define specific strategies for the inclusion of vulnerable groups and for the definition of dedicated information tools and channels.

- *User-centred design framework for disaster risk visualisation*. Research by Twomlow et al. (2022) presents a UCD framework for disaster risk visualisation that involves end-users throughout the development process. It combines the principles and approach of UCD in high-risk Design Risk Management (DRM) scenarios with the risk visualisation framework proposed by Eppler and Aeshimann (2009) and user mental characterisation process developed by Bruine de Bruin and Bostrom (2013). The aim of such framework is to develop solutions that meet needs and characteristics of the end-users and their interpretations of messages, colours (e.g., red can indicate danger in Western cultures, but joy in some Eastern cultures), sounds, and other characteristics of alert systems. The framework is based on an iterative process consisting in three phases:
  i) *Define:* focuses on defining the DRM context, the challenge and the target users, the socio-demographic, economic, cultural, literacy, knowledge of risks and vulnerabilities that may influence the user's visualisation and perception of risk.
  ii) *Design:* involves iterative design cycles, fast prototyping, and regular feedback from end-users. In this phase it is also important to consider the principles of the European Accessibility Act (Directive EU 2019/882) to design inclusive products and interfaces that meet the needs of people with disabilities or vulnerabilities.
  iii) *Refine:* regards the evaluation and implementation of the final solutions. This can be done through simple visualisation tools, or more complex tools that need to be adapted and integrated in the local decision-making process. The evaluation of the solutions will be based on feedback loops by different users that can inform the whole systems and maybe cause the need for a new iteration going back to the previous phase.

The third model is based on user-centred design (UCD) principles applied to the visualisation of information for different target groups. This is relevant for the co-design of communication campaigns.

The following section, *Section 3*, outlines a stakeholder engagement approach for the RETIME project, building on the approaches and frameworks analysed in *Section 2*. The following analysis highlighted different opportunities to adopt specific tools and methods or to adapt techniques and engagement activities for specific and local target groups such as vulnerable people. For example, the DIDRR model can be relevant for the co-design of RETIME solutions by understanding specific needs of people with different types of disability by working with the staff

of social service infrastructures or community centres. The CDR framework can be relevant when considering the co-creation of tools to measure critical resilience dimensions at local level, starting from insights the Social Vulnerability Assessment and the iterative adaptation of solutions through social surveys, focus groups, and validation workshops (that can be run in project RETIME task T2.3 through the implementation of the roadmaps, as designed in *Section 4*). The UCD framework for disaster risk visualisation can be used for the co-design of communication campaigns in collaboration with RETIME Local Desk Members.

3. RETIME approach to stakeholder engagement

This section is based on the definition of stakeholder engagement within the RETIME project that has been included in D2.1 - *Stakeholders Map with profiles, social survey analysis, and defined roles*. RETIME stakeholder engagement activities are designed to support the development of the project's solutions. In addition to each Technology Readiness Level (TRL) indicator, complementary co-design activities (defined within tasks T2.1, T2.2, and T2.3) are needed to capture a more comprehensive picture of the real-world maturity of RETIME solutions, including social, behavioural, and usability dimensions. RETIME approach has been designed by implementing a design thinking process for the definition of the Social Innovation Roadmap.
This section is organised as follows: *Section 3.1* defines the main steps of the design thinking process and how they have been used in task T2.2 to design the RETIME social innovation roadmap. *Section 3.2* describes how the SFDRR principles can be used in the RETIME project considering the stakeholder engagement and co-design approach. *Section 3.3* and *Section 3.4* shows the results from the system mapping workshops and from the technical workshop, respectively.

3.1. Design thinking process for the definition of social innovation roadmap

The Design Thinking (DT) process is a human-centred and iterative approach to problem-solving that focuses on deeply understanding users' needs and developing unique and tailored solutions. It is based on the Human Centred Design (HCD) iterative approach that IDEO has conceptualised as a non-linear process consisting of three main phases (IDEO, 2009): inspiration, ideation, and implementation. Taking the HCD approach as a reference, the Design Institute of Stanford University developed the Design thinking Methodology (Hasso Plattner Institute of Design at Stanford, 2010) guide which is structured in five actions to:
i) ***Empathise:*** It is the first and crucial stage. To create innovative solutions, designers must first understand the users for whom the solution is intended. Through direct observation, active

listening, and user engagement, designers seek to uncover users' emotions, motivations, expectations, and behaviours.

ii) ***Define*:** All the qualitative and quantitative data collected during (i) phase, are then analysed for defining the problem and designing challenges in a clear and structured way, ensuring that the focus remains on user needs and the insights discovered during the research.

iii) ***Ideate*:** A range of ideas are generated to solve the problem and design challenge defined in the (ii) phase, using various brainstorming methods to encourage continuous exploration of creative solutions. Furthermore, suspending the judgment is essential to facilitate the free generating flow of creative and spontaneous ideas.

iv) ***Prototyping*:** The ideas are translated into physical and interactive forms, no matter how raw or simple the ideas are. The aim is to 'build to think', using prototypes to refine concepts, test hypotheses and stimulate deeper conversations with users.

v) ***Testing*:** Prototypes are tested with real users to get feedback in different stages and refine solutions. These phases are also useful to deepen empathy and sometimes to reframe the problem completely.

RETIME Local Desk Members (CML, ŽSK, and IBS) have been asked to identify stakeholders and end-users for the specific solutions developed within the project. During a first round of workshops (one with each LDM), an in-depth analysis of the state of the art regarding the possible implementation of co-design and co-creation activities has been done using system mapping to cover stages (i-ii) of the DT internal process. Then, a second workshop with RETIME Beneficiaries working on the development of digital and physical RETIME solutions, some specific issues for the co-design and co-creation were discussed, covering the stage (iii). A final workshop to test the roadmap was run during the General Assembly meeting on April 2025 (M12) to verify if the roadmap was consistent with the expectations of the RETIME Beneficiaries, and some insights have been collected for the first iteration of the roadmap. *Section 4* describes the results of this iteration and shows the first prototype of the RETIME social innovation roadmap. This will be validated at the beginning of task T2.3 (M14) and then implemented during the RETIME project lifetime.

Specific DT tools and methods were used during the workshops to better understand the interrelations between the different Work Packages, Tasks, and to deploy the solutions. The tools were included in a Miro Board designed to integrate all the different insights from all the workshops (Annex A: RETIME Miro Board Template). This work helped reframing the stakeholder engagement strategy in a more inclusive way.

3.2. The Sendai Framework for Disaster Risk Reduction in RETIME

RETIME solutions are co-designed thanks to the contribution of different stakeholders and end-users through the implementation of Social Innovation Roadmaps (*Section 4*). Roadmaps will be run during the project RETIME lifetime and they will be reinforced by the activities foreseen for the demonstration phase of the project (included in RETIME Work package 5). In this process, the frameworks analysed in *Section 2* can help defining some specific ways in which solutions can contribute to one or more of the SFDRR priorities considering the need to consider perspectives and insights from different stakeholders and the need to adopt an "inclusive" process to consider these needs in the development of RETIME solutions. Based on the four priorities defined within the SFDRR (*Section 2.2*), RETIME co-design of solutions will contribute to:

1. *Understand disaster risk* in all its dimensions of vulnerability, capacity, exposure of people and assets, hazard characteristics and environmental factors, across all stages of risk assessment, prevention, mitigation, preparedness, and response.
   In RETIME, this priority will be achieved through the Social Vulnerability Assessment, considering 'criticality' and 'support capacity' (task T2.1). This analysis is related to all RETIME solutions, especially the hazard identification in three pilot areas (task T3.1), co-design of the IT sensor-based alert system (task T4.3), the Digital Twins for hazard mitigation and resilience awareness (task T4.4), the Resilience Knowledge Hub and the Decision Support System (task T4.6). In developing the Ideathons and Resilience games (task T6.3), it will be also important to involve citizens in understanding disaster risks. A relevant one-stop shop should be available to provide information and Nature-based Solutions for risk reduction.
2. *Strengthen disaster risk governance to manage disaster risk.* In RETIME, this aspect will be considered throughout the co-design of a Decision Support System (DSS), involving different institutions within the local emergency governance system. This system will be integrated into the Resilience Knowledge Hub, which aims at empowering the stakeholders involved in the governance of disaster risk management.
3. *Invest in disaster risk reduction for resilience.* Public and private investments in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries, and their assets, as well as the built environment. In RETIME, the cost-benefit analysis and the business model definition (task T1.4) will allow to configure robust value proposition for all those who will be interested in investing in the selected pilot as well as for the residents or building owners in the pilot cities in Portugal,

Slovakia, and Estonia. The results of this analysis will be then made available to a wider audience of national and European stakeholders that can validate the opportunities from the RETIME project. The DBRP (developed within task T4.5) will allow different target groups to explore renovation strategies from various perspectives, including financial considerations. This tool includes basic functions (such as return on investment and net present value calculations) to help assess financial and cost feasibility.

4. *Enhance disaster preparedness for effective response and to 'Build Back Better' in recovery, rehabilitation, and reconstruction*. The increasing disaster risk underscores the need to enhance disaster preparedness for response, take anticipatory actions, and ensure effective response and recovery at all levels. The recovery phase is a crucial opportunity to build back better by integrating disaster risk reduction into development. In RETIME, this will involve co-designing the Digital Building Renovation Passport involving data of the three pilots, alongside the development of the BIM models and the Sensor-based IT alert system for the definition of Digital Twins (task 4.4) to inform local risk management actors through different digital predictive tools. The co-design of the Resilience Hub and Decision Support System (task T4.6) will be also relevant to facilitate citizen science activities around urban resilience focusing on user-stories about successful implementations, problems encountered and cook-books for replication.

The characterisation of the engagement activities defined in the Social Innovation Roadmap will consider principles of the SFDRR and the phases of the PPRR model to include as much as possible all the target groups in the co-design of the solutions. The work done through the internal RETIME workshop helped to define how the activities should be relevant for different stakeholders and what kind of co-design level is it possible to achieve considering the state of the art, the limitation in reaching some stakeholders and the opportunities that will come during the solutions' demonstration phase (WP5).

3.3. System mapping workshop

The system map is a tool that derives from System Design Thinking and provides a visual representation of all the actors involved in the system, showing their interconnections and interdependencies. Through this representation, the partners involved can understand the system in a participatory way, reflecting and discussing on the dynamics of mutual interaction and implementation between the different elements and actors. Furthermore, the system map contributes to clarifying the role of each actor (internal or external) identified by the project partners within the represented system.

The RETIME workshop activities conducted in online remote mode[12] with the three LDMs (CML, ŽSK, and IBS) were aimed at adapting the System Map template for the RETIME context, making it applicable and scalable to the co-design of the different solutions. The members of the pilot cities not only reflected on the positioning and the interdependencies between the different actors and elements of the system at a general level, but also on the role of the different stakeholders in the four phases of disaster risk management outlined in the PPRR model.
Figure 3 shows the RETIME System Map template, structured around the following steps:

- *Scenario definition:* participants defined the scenario in which the selected solution is used through a statement.
- *Stakeholder identification:* the RETIME Local Desk Members (LDMs) refined the stakeholders previously identified (within task T2.1) using the Stakeholder Engagement Options Framework (SEOF) and the Power-Interest Matrix (PIM) (Phua and Rong, 2023). They categorised them according to the five levels of engagement: inform, consult, involve, collaborate, and empower.
- *System elements:* Beyond stakeholders, participants identified other relevant system elements for each solution (tools, data sources, infrastructure, policies, and barriers).
- *System mapping:* The stakeholders and system elements were placed on a system map with five concentric circles representing the levels of engagement. The map is also divided into four quadrants aligned with the PPRR model. This helps to define the role of each stakeholder in the risk management phases.
- *Relationships between system elements:* At the end, the participants should connect actors that are somehow related to other system elements earlier identified.

The RETIME System Map serves as a guiding tool in the first session of the workshop to outline the engagement and co-design strategy for each RETIME solution. The workshops results highlighted the need to align all the LDMs around a clearer understanding of how the co-design of the solution could lead improvements in local disaster risk management services or local resilience strategies. The RETIME solutions Sensor-based IT automated alert systems (that include the data integration into the hardware totems), and the RETIME Resilience Hub and Decision Support Systems have been discussed as two of the most relevant solutions for what regards the engagement of different stakeholders and end-users. These solutions require

[12] Three on-line workshops held on February 2025, one with the representatives of each pilot site, with a total of 38 participants from RETIME Beneficiaries.

highest level of tailored and personalised interaction in terms of features, interfaces, and interaction tools with the end-users. This consideration was discussed with SMEs partners to better understand the limitations in considering different type of co-design activities with different end-users. The discussion resulted in the need to have a specific technical workshop that is described in *Section 3.4*. At the same time, the need to have an integrated workshop during the General Assembly on April 2024 (M12) was discussed with RETIME Beneficiaries in order to have a clear and complete overview of the integration of co-design and engagement activities in the overall RETIME project plan to deploy the solutions at the different TRL levels indicated in the proposal; findings from this last workshop are included in *Section 4*.

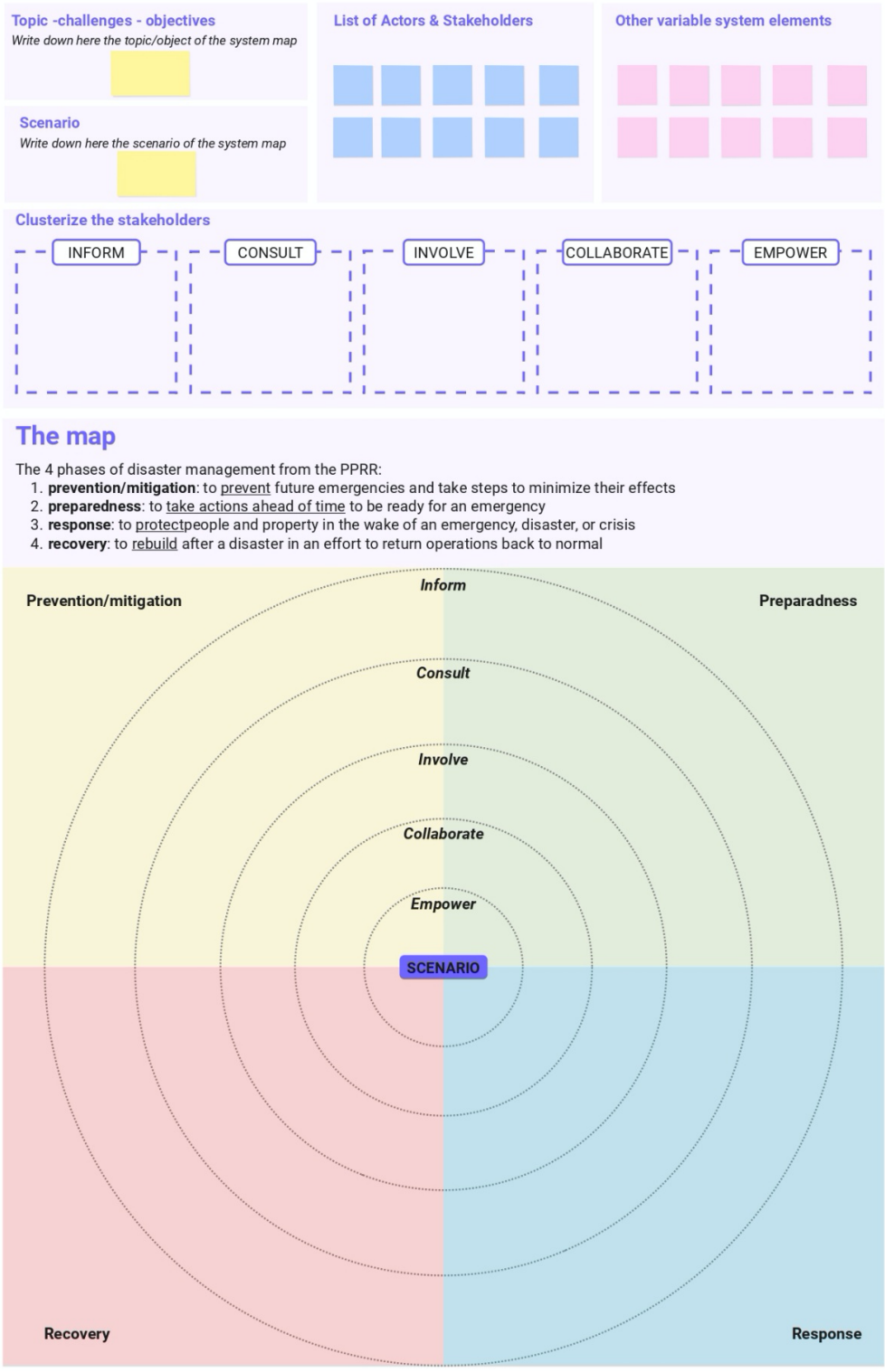


Figure 3. RETIME System map template.

3.4. Technical workshop

Based on the results and insights from the system mapping workshops, a technical RETIME workshop[13] was held on March 2025 to explore specific aspects related to engaging different target groups in the co-design of the solutions. The workshop identified common action points that should inform the engagement strategy for each RETIME solution. These points are key to shaping the co-design approach, as specific stakeholders and end users must be involved at different stages of solution development. Each solution should consider the following:

- Design user stories based on available data and defined value proposition canvas for different target groups
- Coordinate with other RETIME Beneficiaries the integration of different part of the solution
- Identify the most relevant data sources and explore the integration of data sources (e.g., GIS and 2D/3D parametric models) within the solutions
- Collect data from local emergency protocols and define how they can be effectively integrated into the proposed solutions
- Recognise and address potential communication biases among stakeholders involved in emergency management within each pilot
- Prepare a roadmap of the development for each solution
- Collect and consider feedback from stakeholders and end-users in the development and deployment of solutions by iterative validation phases

The information from the technical workshop were then validated with the RETIME LDMs to align local needs with technical requirements. *Sections 3.4.1* and *3.4.4* outline specific inputs emerged during these workshops for each solution to be developed. All these considerations were then integrated in *Section 4* through the design of the social innovation roadmap.

[13] Online workshop with a total of 27 participants.

3.4.1. RETIME Sensor-based automated IT alert system

The Sensors for IT automated alert will be developed by involving public and private suppliers, which have access to specific data from environmental sensors.[14] In terms of stakeholder engagement, it is important to define the strategy for exploring the opportunities the RETIME solutions can offer to different stakeholders and target user groups.
The sensor IT automated system includes a hardware totem, which is a prototype (or demo unit). Type of information, language, user interface, and other data requirement depends on preferences and requirements defined by potential end-users, IT providers, and local representatives of public authorities. This hardware totem will be tested in conditions that simulate the real conditions in each pilot site. It will display content accessible in a unique physical tool to provide timely alerts on adverse weather or emergencies, along with information on resilient, innovative solutions through advanced interactions.
It may be necessary to involve key external providers that have access to sensors data and datasets, for example for weather data, at national, regional, and local level. Data from the Copernicus platforms (CEMS, CDS, CAMS), can be used to implement some technical aspects and co-design some specific features of the alert system in each pilot.[15]
Specific action points for the development of this solution thus emerged:

- Ensure all permissions for sensor installation and the use of other data in each pilot are obtained.
- Identify and engage with external stakeholders for sensor data collection or data use.
- Identify the target groups for the hardware totem in each pilot city.
- Collaborate with local organisations to gather insights on vulnerable groups
- Define the specific alerts and information to be communicated through the hardware totem and any additional plug-and-play IoT devices, ensuring integration with existing systems.
- Collaborate with local organisations and authorities to gather insights on vulnerable groups and their needs and preferences.

[14] Technical information on the installation of sensors (or data integration of existing sensors) are included in deliverable D1.3 - *Report on data specification requirements framework Part 1* and it will be updated in deliverable D1.5 - *Report on data specification requirements framework Part 2*.
[15] Other information on sensors and dataset can be found in deliverables D1.1 - *Report on urban vulnerability and risk assessment (multi-risk resilience) methodologies and tools*, D1.3 - *Report on data specification requirements framework Part 1*, and D7.4 - *Data Management Plan*.

- Develop a strategy for testing the hardware totem with relevant local stakeholders and institutional bodies.

3.4.2. RETIME Digital Twins

The RETIME Digital Twins require data from the BIM models, which in turn depend on the ability to scan buildings and their surrounding environments. These models intend to help to design and define virtual scenarios regarding the emergency protocols. They can then be used for predictive actions on the behaviour of buildings in different emergency scenarios.
Specific action points for the development of this solution emerged:

- Support RETIME pilots in gathering data on the digital twin simulator's requirements.
- Organise validation sessions with RETIME local stakeholders before the testing phases.

3.4.3. RETIME Digital Building Renovation Passport

The RETIME Digital Building Renovation Passport (DBRP) requires datasets on energy performance certificates. DBRP will benefit from the BIM modelling tools and will take data from environmental sensors within the building to define specific renovation strategies for each building. Different data sources should be considered, as data for the indoor air quality, data regarding the comfort of building occupants, energy performance data from indoor sensors or related to seismic performance. The DBRP will give as an output a renovation roadmap considering different variables and conditions related to single building or building blocks, namely exposures, vulnerabilities and hazards associated with neighbourhoods, energy simulations of buildings and financial feasibilities to install selected renovation measures.
This passport should be connected to the vulnerability database developed within the project, to the GIS systems and to IT sensors datasets that will be made available. It is intended for the analysis of user interface to be made at neighbourhood scale and not only on a single building.
Additional features (for example costs and savings from renovation intervention) will be included in the RETIME DBRP but this should be done in an integrated adapted way across the pilot sites.
Seven identified end-users of DBRP are outlined below:

1. Building tenant or flat tenant
2. Building owner or flat owner
3. Building manager
4. Utility or service provider
5. Design studio, construction company, or building certification agency
6. Financial institution or insurance company

7. Municipality or other public authority

Specific action points for this solution emerged to achieve the following objectives:

- Gather information on energy performance certificates and dynamic data sources to support the development of the RETIME Building Renovation Passport.
- Coordinate with partners to ensure all necessary data is included in RETIME renovation roadmap.
- Analyse data from different climate stressors across the different pilot sites to enhance the mitigation and adaptation strategies for each building or building block.
- Identify key stakeholders to involve in the testing phases who will contribute to an effective use, replication, and exploitation strategy for this tool.
- Analyse data from different climate stressors across the different pilot sites to enhance the mitigation and adaptation strategies for each building or building block.

3.4.4. RETIME Resilience Knowledge Hub and Decision Support System

The GEOIKP platform[16] will be used as a basis for the development of the RETIME Resilience Knowledge Hub and the Decision Support System. This open access platform is a kind of one-stop shop for Nature-based Solutions useful to be implemented in disaster risk and reduction plans and strategies. This platform allows different target groups to find useful information, protocols, datasets, and technical solutions that can be implemented at local level. It is also a repository of case studies on how to implement specific solutions for nature-based intervention in single buildings or at city level.

The RETIME Resilience Knowledge Hub aims to implement different scenarios, community emergency planning tools, simulation of impact of disasters, and other tools to act as an informed and participatory dissemination platform. The RETIME Resilience Knowledge Hub can inform on general hazard or risks related to different possible vulnerabilities and help local communities and policymakers to make assumptions on potential interventions.

[16] Developed under the Operandum Horizon 2020 project (Grant Agreement numb. 776848), https://geoikp.operandum-project.eu/home

4. Social Innovation Roadmap of the three RETIME pilot sites

This section outlines the main insights related to the engagement of different target groups gathered during previous in situ social surveys (undertaken within task T2.1) as well as during the RETIME internal workshop held during the second General Assembly of the project (Žilina, 9-10 April 2025). The workshop aimed to gather the information (following the steps described in *Section 3*) and design the roadmap. Through the interactive online tool, Miro Board, the interactions among the different tasks for each solution were mapped as well as the identification of the target group, the activity, and the related tentative timeline.

4.1. Stakeholder engagement strategies in RETIME pilot sites

Section 4.1 outlines how key stakeholders will be included in the co-design of the solutions across RETIME each pilot, as defined during the workshops, throughout the project. An overview is provided on approaches for involving target groups in co-design activities, along with specific issues that emerged during the RETIME workshops for each pilot.

4.1.1. Lisbon pilot - Bairro da Boavista

RETIME solutions will be deployed in a primary school and two building sections, all owned by the Lisbon Town Council (CML) and managed by Gebalis. Due to its centrale role and as owner of the *Bairro da Boavista* pilot, the CML will manage the relationship with all key stakeholders under its direct control, including municipal actors such as Gebalis, the Department for Civil Protection, Directorate on Maintenance and Conservation, Urban Information Service, Police and Firefighters Corps, Centro de Informação Urbana (CIUL), as well as other relevant bodies in *Bairro da Boavista*. These actors are involved in specific co-design activities when needed. CML will organise participatory workshops with citizens to collect input for Ideathon, the validation of the serious games (task T6.3), and for the co-design of contents of the RETIME Resilience Hub and DSS.
Gebalis is the primary stakeholder responsible for organising meeting with building occupants. Two specific places have been identified for the deployment of RETIME solutions: a school and two building sections owned by CML and managed by Gebalis.
For what regards the territorial organisations (such as associations representing the interest of specific vulnerable groups, recreational associations, or sports clubs), during the workshop emerged how these organisations are not directly involved in the definition or co-design of the local emergency plans. However, they are only activated when an emergency occurs, to assist

local inhabitants in finding a safe place to stay, identify common meeting points, and accessing recovery information after the emergency. Given that, it is essential to involve them in the co-design and testing phases of risk information visualisation, to consider specific requirements and ensure that both hardware and software are adapted to be user-friendly. The information that can be visualised through the RETIME totem solution should be organised in an inclusive and accessible way for different vulnerable groups, following the Universal Design Principles and the DIDDR framework.

From the official data and social surveys conducted within task T2.1 emerged that, in general, the local population has a limited level of usage of digital tools. This means that when planning co-design activities with inhabitants (as outlined in the stakeholder mapping within task T2.1), special attention should be given to defining how to carry out the validation and testing activities. They should include not only digital prototypes, but also physical artefacts or mock-ups, supported by simple surveys or, preferably, focus groups and other participatory methods to gather feedback and foster dialogue.

Table 1 provides and overview of the engagement level of key stakeholders in *Bairro de Boavista*, defined with the Power-Interest Matrix exercise undertaken during the first year of the project (as detailed in deliverable D2.1 - *Stakeholders Map with profiles, social survey analysis, and defined roles*). Table 2 identifies engagement objectives that can be relevant for different stakeholders based on the engagement level for each solution.

Table 1. Engagement level of key stakeholders in co-design of RETIME solutions in Bairro de Boavista.

Stakeholders	Sensor-based alert system	Digital Twin	DBRP	Resilience Hub and DSS
CML	Empower	Empower	Empower	Empower
Gebalis	Empower	Empower	Empower	Empower
Benfica Parish Council	Collaborate	Collaborate	Collaborate	-
Local citizen-led organisations (residents, elderly, youth, Cape Verdean)	Collaborate	-	-	Collaborate
Monsanto Health Unit	Consult	-	-	-
Boavista Sport Clubs	Consult	-	-	-
Sample of inhabitants	Consult	-	-	Consult
Building occupants (local inhabitants and local workers, building occupants)	Consult	Inform	Inform	-

Table 2. Specification of engagement objectives for each RETIME solution in Bairro de Boavista.

RETIME Solution	Target group(s)	Engagement level	Engagement objectives
Sensor-based IT automated alert system	CML	Empower	CML will define the localisation of sensors and the integration of the emergency plans through data from the alert system.
	Gebalis	Empower	Gebalis will be the local contact point for the co-design of a communication campaign regarding the visualisation of risks tools and channels.
	Benfica Parish Council	Collaborate	Benfica Parish Council might be interested in the integration of this solution in the information system of the district on hazards and risks.
	Local organisations	Collaborate	Local organisations can collaborate as local activators of their members in workshops or give direct feedback in the testing phases of the solution.
	Monsanto Health Unit	Consult	Monsanto Health Unit can be consulted with regards to some health and well-being issues related to some risks or hazards in the neighbourhood. They can be involved in workshops related to the visualisation of information on risks.
	Boavista sport clubs	Consult	Boavista sport clubs can contribute to gather feedback on stakeholders' requirements and preferences.
	Local inhabitants and local workers	Consult	Local inhabitants and local workers can be consulted for feedback once the solution has been co-designed. While direct involvement in co-design or co-creation activities may be challenging, some co-creation workshops can be facilitated through the local citizen-led organisations.
	Building occupants (where the solutions will be deployed)	Consult	Relevant building occupants should be consulted for getting feedback on alert strategies related to buildings and on the installation and functioning of the sensors in the buildings.

RETIME Solution	Target group(s)	Engagement level	Engagement objectives
Digital Twins	CML	Empower	CML plans to integrate its existing emergency management system with this new solution. The information system centre (CIUL) and emergency planning centres will work side by side with technical SME and academic partners (ISCTE, KAJO, ONE, TUU, UD, and UPORTO) in the co-design of this solution.
	Gebalis	Empower	Gebalis will be directly involved in the scanning phase of the selected buildings and empowered on how to use of the planned tools for the improvement of the selected buildings.
	Benfica Parish Council	Collaborate	Benfica Parish Council can collaborate in collecting and providing dataset local-level sensors and in identifying other buildings that have been refurbished or retrofitted within public renovation plans.
	Building occupants	Inform	Building occupants should be informed about this solution to understand how their comfort or living conditions can be improved.
Solution	**Target group(s)**	**Engagement level**	**Engagement objectives**
Digital Building Renovation Passport	CML	Empower	The DBRP can be used in case of planning of local intervention to contrast energy poverty and the renovation roadmaps can be interesting for the definition of future interventions in this neighbourhood and in other districts. CML will be involved in the definition of the main characteristics of the DBRP for Lisbon.
	Gebalis	Empower	This solution can help influence the investments in renovation of this neighbourhood. Members of Gebalis will be empowered by co-creating the Graphical User Interface (GUI) of the BRP renovation roadmap functionality. The installation of measures to improve the energy performance of the building will be suggested in a specific order, considering energy simulations, costs and risks concerning the asset and its surroundings
	Benfica Parish Council	Collaborate	As Benfica Parish Council are involved in the decision on investments in local infrastructures and buildings, they can suggest the piece of information they would like to find in the BRP.
Solution	**Target group(s)**	**Engagement level**	**Engagement objectives**

Resilience Knowledge Hub and Decision Support System	CML	Empower	This solution will gather data on potential actions to be taken at city/district/neighbourhood level with regards to Nature-based Solutions to mitigate and adapt to climate change. The engagement of CML will be crucial to develop some user stories and to integrate different policy developed at local level in the platform.
	Gebalis	Empower	Gebalis can be empowered to use the DSS to implement impact-based triggers level for local buildings.
	Local organisations	Collaborate	The Hub will include citizen stories based on citizen science tools. Local organisations can collaborate in collecting such stories from local inhabitants and upload them to the platform.
	Local inhabitants	Consult	Engaged local inhabitants can be consulted to share their stories regarding mitigation and adaptation to climate change.

4.1.2. Zilina pilot - Zástranie district

A specific building, the Straník social services facility, has been selected in the Zástranie district, for the deployment and testing of the RETIME solutions. This building accommodates individuals experiencing mental health challenges, with varying levels of social and physical vulnerability. Therefore, the roadmap should include specific co-design activities to address the needs of working with this target group, particularly by focusing on the activation and capacity building of the staff at this facility, as well as consulting with the family members of the building occupants. This activity can be tested in the Straník facility and then organised with other stakeholders active in the social sector at city level (e.g., other public-owned or private managed services facilities and buildings) to define common patterns to Disaster Risk and Resilience considering different vulnerable groups (including Ukrainian Refugees and elderly). It will be necessary to involve the local Department for Social Services, which oversees activities and policies related to these facilities. Besides the Straník social services facility, other activities should be carried out at city level to engage different target groups in the co-design of solutions, for example, regarding the RETIME sensor-based IT alert system for which different target groups should be involved. During the workshop during the GA meeting, the idea was proposed to transform the Ideathon into a Mapathon, mapping sensors and hotspots in the centre of Žilina with direct citizen involvement. This should be relevant for the implementation of the RETIME Resilience Knowledge Hub and Decision Support System with the involvement of the citizens through citizen science activities. Last, specific activities should be done to engage and empower the governmental departments related to disaster and crisis management (e.g., Integrated Rescue System Coordination Centre and Fire and Rescue and Police corps at district and regional level). The aim is to identify common needs for the implementation of RETIME solutions. In Žilina, in addition to the sensors to be installed in the Straník social services centre, other existing data could be used.
Table 3 shows the engagement levels of different stakeholders in Zástranie district for each RETIME solution, while Table 4 outlines the engagement activities for each key stakeholder.

Table 3. Engagement level of key stakeholders in the co-design of RETIME solutions in Zástranie district.

Stakeholders	Sensor-based alert system	Digital Twin	DBRP	Resilience Hub and DSS
Straník Staff	Empower	Empower	Empower	Empower
Straníkfamily members	Consult	-	-	Consult
Diocesan Charity	Empower	-	Empower	Empower
Department of Social Services of the Žilina Region	Collaborate	Collaborate	Collaborate	Collaborate
Social Services facilities (Harmony - Letokruhy - Synnómia)	Collaborate		Collaborate	Collaborate
Support Service Agency	Collaborate	-	-	-
Association supporting individuals with mental disabilities	Collaborate	-	-	Collaborate
Association of social services providers	Involve	-	-	Involve
Social Counselling centres	Consult	-	-	-
Center for Design for All	Involve	-	-	Involve
Department of Chief Architect	Consult	Consult	Consult	Consult
Construction Office	Consult	Consult	Consult	Consult
Department of Investment			Empower	
District Office Department of crisis management	Collaborate	Collaborate	-	Collaborate
City of Žilina Crisis Management and Security	Collaborate	Collaborate	-	Collaborate
Integrated Rescue System Coordination Centre	Consult	Consult	-	Consult
Žilina District and Regional Directorate of Fire and Rescue Corps	Involve	Involve	-	Involve
Žilina District and Regional Directorate of Police Corps	Consult	Consult	-	Consult
Residents	Consult	-	-	Consult
Unity of Pensioners Slovakia	Inform	-	-	Inform
Slovak Republic Army	Inform	-	-	Inform
Slovak Association of Insurance Companies	Inform	-	Inform	Inform

Table 4. Specification of engagement objectives for each RETIME solution in Zástranie district.

Solution	Target group(s)	Engagement level	Engagement objectives
Sensor-based IT automated alert system	Straník Staff	Empower	Straník Staff will be involved in different activities to define specific requirements related to the sensors, the existing emergency plans, and current alerting systems. They can then work together with clients using specific methodologies (based on the individual's residual ability) to identify the best way to integrate alarms through information interfaces that can be adapted to clients' needs.
	Straník family members	Consult	Parents of the clients can be consulted to understand if alternative approaches would be more relevant in working with their relatives.
	Diocesan Charity	Empower	This organisation runs activities in facilities similar to Straník and can be interested in implementing project outputs.
	Department of Social Services	Collaborate	They should collaborate to define the alert system also training the staff working in other facilities in the city.
	Social Service facilities	Collaborate	Staff at these facilities can contribute to defining specific building occupancy requirements or other performance-based indicators relevant to their buildings.
	Support Service Agency	Collaborate	This agency can collaborate on understanding capacity building needs of workers in this sector.
	Association supporting mental disabilities	Collaborate	The association can support the definition of specific methods to work with mentally ill clients in different emergency scenarios.
	Association of social service providers	Involve	This association can be involved in the definition of a specific set of functions for the whole service system in Žilina.

	Social Counseling centres	Consult	They can provide general and non-sensible information on their clients in relation to the adaptation to extreme events.
	Centre for Design for All	Involve	They can be involved in running engagement activities in the facilities.
	Department of Chief Architect	Consult	They can be consulted for the identification of other sources of data from local sensors.
	Construction Office	Consult	They can be consulted for the identification of other sources of data from local sensors.
	District Office Department of crisis management	Collaborate	They can collaborate on the identification of the different actors in the governance of crisis management and implement this solution in their IT system.
	City of Žilina Crisis Management and Security	Collaborate	They can collaborate on the identification of the different actors in the governance of the Crisis management and implement this solution in their IT system.
	Integrated Rescue System Coordination Centre	Consult	They can be consulted for the implementation of the alert system in their everyday work.
	Žilina District and Regional Directorate of Fire and Rescue Corps	Involve	They can be involved in setting some of the alert system with regards to their role.

	Žilina District and Regional Directorate of Police Corps	Consult	They can be consulted for feedback on the solution.
	Residents	Consult	They can be consulted in relation to the information from the alert system and can give feedback.
	Unity of Pensioners Slovakia	Inform	They can be informed about the solution.
	Slovak Republic Army	Inform	They can be informed about the solution.
	Slovak Association of Insurance companies	Inform	They can be informed about the solution.
Solution	**Target group(s)**	**Engagement level**	**Engagement objectives**
Digital Twins	Straník Staff	Empower	The building manager or the responsible of the Straník house should be involved to obtain necessary permissions and give access to the building, where automated surveys and modelling will be performed.
	Department of Social Services	Collaborate	They can collaborate to the development of the DT through the implementation of social service plans at the regional level.
	Department of Chief Architect	Consult	They can provide information on the implementation of the local urban plans and the BIM models.
	Construction Office	Consult	They can provide information on the implementation of the local urban plans and the BIM models.
	District Office Department of	Collaborate	They can collaborate to the development of the emergency plans and the AR/VR system

	crisis management		
	City of Žilina Crisis Management and Security	Collaborate	They can collaborate on the development of emergency plans and the AR/VR system.
	Integrated Rescue System Coordination Centre	Consult	First responders can be consulted for co-designing some of the features related to the Digital Twins.
	Žilina District and Regional Directorate of Fire and Rescue Corps	Involve	They can be involved in the definition of the protocols for fire and rescue activities to be implemented in the AR/VR model.
	Žilina District and Regional Directorate of Police Corps	Consult	They can be consulted for feedback on the solution.
Solution	**Target group(s)**	**Engagement level**	**Engagement objectives**
Digital Building Renovation Passport	Straník Staff	Empower	They need to be empowered on the different interfaces and solutions related to the renovation programme or be implemented in the building.
	Diocesan Charity	Empower	They are interested in implementing the solution in their facilities.

	Department of Social Services	Collaborate	They can plan renovation roadmaps for different facilities at the regional level.
	Social Service facilities	Collaborate	They can actively identify potential interventions needed in each facility.
	Department of Chief Architect	Consult	They can be consulted on the feasibility and potential for implementing the renovation roadmaps and proposed interventions.
	Construction Office	Consult	
	Department of Investment	Empower	They can plan specific interventions in some facilities together with the other governmental departments.
	Slovak Association of Insurance Companies	Inform	They can be informed on the renovation roadmaps and related insurance issues.
Solution	**Target group(s)**	**Engagement level**	**Engagement objectives**
Resilience Knowledge Hub and Decision Support System	Straník Staff	Empower	They can contribute to the development of the user interface and share stories about the renovation of their building.
	Straník family members	Consult	They can share stories about how the renovation has impacted their relatives's lives.
	Diocesan Charity	Empower	They can be interested in the Resilience Knowledge Hub as a tool to plan intervention in their facilities.
	Department of Social Services	Collaborate	They can collaborate with the development of an interface useful for the workers and the clients at the regional level.
	Associations for individuals	Collaborate	They can enhance the accessibility of the platform.

	with mental disabilities		
	Associations of social service providers	Involve	They can invite their members in testing the platform
	Centre for Design for All	Involve	They can take part in RETIME engagement activities.
	Department of Chief Architect	Consult	They can provide dataset in the Resilience Knowledge Hub and for the development of the interface of the DSS to suit their needs.
	Construction Office	Consult	
	District Office Department of crisis management	Collaborate	They can identify different actors in the governance of the Crisis management and implement this solution in their IT system
	City of Žilina Crisis Management and Security	Collaborate	They can collaborate on the identification of the different actors involved in crisis management and implement this solution in their IT system.
	Integrated Rescue System Coordination Centre	Consult	They can be consulted on the implemented solution.
	Žilina District and Regional Directorate of	Involve	They can be involved in co-designing some of the features of the Resilience Knowledge Hub and DSS to suit their needs.

	Fire and Rescue Corps		
	Žilina District and Regional Directorate of Police Corps	Consult	They can be consulted on the implemented solutions.
	Residents	Consult	They can be consulted on the implemented solutions and for sharing citizen stories.
	Unity of Pensioners Slovakia	Inform	They can be informed about the solutions deployed within RETIME.
	Slovak Republic Army	Inform	They can be informed about the solutions deployed within RETIME.
	Slovak Association of Insurance Companies	Inform	They can be informed about the solutions deployed within RETIME.

4.1.3. Tartu pilot - Tartu's historic centre

Tartu is the pilot with the highest level of digital literacy and formal educational level among the three selected for RETIME project. Furthermore, stakeholders in this city are continuously engaged in relevant projects related to climate change adaptation and mitigation, and they have a good knowledge of risk and resilience issues. The information gathered through the internal workshop highlighted the importance of clearly defining a value proposition for each proposed RETIME solution in Tartu's historic centre to get people involved and engaged. Clarifying the value proposition is essential for engaging stakeholders in Tartu within the RETIME project. For this reason, value proposition design workshops with members of the RETIME project consortium will be organised as one of the first activity related to the roadmap implementation at the beginning of task T2.3. Table 5 shows the engagement level of stakeholders in Tartu's historic centre,[17] while Table 6 outlines the engagement activities for each stakeholder.

Table 5. Engagement level of key stakeholders in the co-design of RETIME solutions in Tartu's historic centre.

Stakeholders	Sensor-based alert system	Digital Twin	DBRP	Resilience Hub and DSS
Housing associations	Empower	Empower	Empower	Empower
Building managers	Collaborate	Collaborate	Collaborate	Collaborate
Tartu City Government Crisis Coordinator	Collaborate	Collaborate	Collaborate	Collaborate
Tartu City Government Spatial Planning Department	-	Consult	Consult	Consult
Tartu City Government Architecture and Construction Department	-	Consult	Consult	Consult
Tartu City Government Urban Property Department	-	Consult	Consult	Consult
Estonian Southern Rescue Board Centre	Collaborate	Collaborate	Collaborate	Collaborate
Sensor managers (or service providers)	Collaborate	Collaborate	Collaborate	Collaborate
Associations supporting vulnerable citizens	Consult	-	-	Consult

[17] Building on the theoretical framework proposed by Bammer (2021), a preliminary analysis on the levels of stakeholder engagement was developed for each RETIME pilot site in D2.1. This includes the identification of key stakeholders, stakeholder mapping with profiles, a social survey analysis, and the definition of stakeholder roles.

Associations supporting Ukrainian refugees	Inform	-	-	Inform
Local police service	Inform	Inform	-	Inform
Environmental Investment Centre	Inform	-	Inform	Inform

Table 6. Specification of engagement objectives for each RETIME solution in Tartu's historic centre.

Solution	Target group(s)	Engagement level	Engagement objectives
Sensor-based IT automated alert system	Housing Associations	Empower	Housing Associations will be empowered by providing them with the technology developed in the project (e.g., hardware and IT solutions). They will be a relevant stakeholder to engage private owners (their members) to give access to data in their buildings and apartments.
	Building managers	Collaborate	They can give access to building information embedded in BIM models and they can help to implement the alert system
	Crisis Coordinator	Collaborate	They can offer input on current plans as well as take input from the sensor-based alert-system.
	Estonian Southern Rescue Board Centre	Collaborate	They provide crisis training for civilians and they share information on how to act during a crisis. They can collaborate to the definition of the impact-based triggers and the emergency plans, and they can be involved in specific training workshops.
	Sensor managers (or service providers)	Collaborate	They can provide info about existing sensors at city level. Specifically, sensors installed in the building Tähe 2 in Tartu within the project SmartEnCity (https://smartencity.eu/)[18].
	Associations supporting vulnerable people	Involve	They will be involved in the definition of specific risk visualization tools and contents. At least one public meeting involving these associations should be organised to explain the features of the new system and collect feedback with regards to the needs of the target groups.
	Associations working with Ukrainian refugees	Inform	They will be informed of the new alert system. Translated leaflet regarding the new visualisation of risk will be needed to inform them.
	Local police service	Inform	They will be informed about this solution, the potential impact on their behaviour and knowledge.
	Environmental Investment Centre	Inform	They will be informed about this solution.

[18] Tartu ICT platform aimed to collect and analyse city-wide public and private data, offering a user-friendly interface for accessing real-time city information. Originally developed for Tartu, it was later adapted for Sonderborg and is also used to monitor the retrofitted pilot area, buses, bike-sharing, and more. It is no longer functional.

Solution	Target group(s)	Engagement level	Engagement objectives
Digital Twins	Housing associations	Empower	They can be empowered through the acquisition of tools or software that can help the management of house owners in terms of risk resilience.
	Building managers	Collaborate	They can provide inputs for the DT.
	Crisis Coordinator	Collaborate	They can collaborate on the definition of emergency plans and in the implementation of the AR/VR part of the DT.
	Spatial Planning Department	Consult	Local blueprints and plans developed in Tartu are being studied by RETIME Beneficiaries to define specific activities for the co-design of this solution. They can be consulted for the BIM models and scanning process.
	Architecture and Construction Dept	Consult	They can be consulted for the BIM models and scanning process.
	Urban Property Department	Consult	They can be consulted for the BIM models and scanning process.
	Estonian Southern Rescue Board Centre	Collaborate	They can provide information on crisis plans.
	Sensor managers (or service providers)	Collaborate	They can give access to existing information at city or county level.
	Local police service	Inform	They will be informed about the solution.
Solution	**Target group (s)**	**Engagement level**	**Engagement objectives**
Digital Building Renovation Passport	Housing associations	Empower	They can be empowered through the implementation of the renovation roadmap that can help to define potential resilience intervention for their members.
	Building managers	Collaborate	They can collaborate in the identification of information on selected buildings.
	Crisis Coordinator	Collaborate	They can collaborate in the definition of some of the features of the DBRP.
	Spatial Planning Department	Consult	They can provide information on the Performance Certificates and other sources to complete the DBRP.

	Architecture and Construction Department	Consult	The Estonian national platform for Energy Performance Certificates will be used for the integration of the DBRP in Tartu. The municipality can help in retrieving data at local level.
	Urban Property Department	Consult	They can provide information about the Performance Certificates and other sources to complete the DBRP.
	Estonian Southern Rescue Board Centre	Collaborate	They can collaborate in the definition of the BRP renovation roadmap functionality. They could be interested in evaluating if the suggested building measure installations contribute to mitigate specific risks for inhabitants.
	Sensor managers	Collaborate	They can collaborate in the definition of some of the features of the DBRP.
	Environmental Investment Centre	Inform	They can be informed on the renovation plans and roadmaps.
Solution	**Target group(s)**	**Engagement level**	**Engagement objectives**
Resilience Hub and Decision Support System	Housing associations	Empower	They can be interested in the information on the different tools developed in the DSS and they can share stories on the platform.
	Building managers	Collaborate	They can be interested in some of the solution proposed on the platform and collaborate to sharing information on the solutions implemented in their building.
	Crisis Coordinator	Collaborate	They can be interested in the DSS as a tool to support informed decision on crisis management at local level.
	Spatial Planning Department	Consult	They can be consulted for the implementation of some specific features.
	Architecture and Construction Department	Consult	They can be consulted for the implementation of some specific features.
	Urban Property Department	Consult	They can be consulted for the implementation of some specific features.
	Estonian Southern Rescue Board Centre	Collaborate	They can collaborate by providing training materials and information on emergency plans.

	Sensor managers (or service providers)	Collaborate	They can share access to information.
	Associations supporting vulnerable citizens	Consult	They can be consulted for making the platform accessible for different target groups.
	Associations supporting Ukrainian refugees	Inform	They can be informed about this solution.
	Local police service	Inform	They can be informed about this solution.
	Environmental Investment Centre	Inform	They can be informed about this solution.

4.2. RETIME Social Innovation Roadmap

The RETIME Social Innovation Roadmap is a living document used for monitoring the engagement project. It will help Local Desk Members in the implementation and deployment of engagement activities at local level and includes:

- *Solution* or part of the solution for which co-design or co-creation activities will be run.
- *Engagement objectives* for each solution or part of the solution.
- *Engagement activity* (detailed in *Section 4.2.1*)
- *Engagement level* that can be reached through the specific activity
- *Timeline*, which includes the relevant validation touchpoints (deliverables, milestones, and project meetings) for each solution so that the roadmap is fully aligned with the RETIME project outputs and outcomes.

Annex B shows the template of the roadmap, while the Social Innovation Roadmap is stored in the project SharePoint folder. Monitoring sessions are planned on a four-month period to track the progress. Both local desk and SME or academic partners developing the different solutions will take part in these meetings to review the progress on each activity and address any needs that have emerged while working with stakeholders.

4.2.1. Engagement and co-design activities

As indicated in *Section 3*, the Design Thinking (DT) methodology has been used for the definition of the RETIME co-design process, considering five iterative stages for co-design of products and services. During each stage, different methods and tools will be used to engage local stakeholders in co-design activities and in collecting feedback.
A list and short description of potential activities that can be organised within RETIME is provided in Table 7. Target activities on this list should be selected and validated by each Local Desk Member. This list may evolve over the course of the project, as new and more relevant activities are identified. The methods and tools outlined in Table 7 relies on the work previously coordinated by ICONS in following projects: EHHUR (*D2.1. Catalogue of engagement tools and co-design models*) and BuildON (*D2.2. Users' engagement and participatory action plan*).[19] The

[19] EHHUR (EYES HEARTS HANDS Urban Revolution, Grant Agreement n. 101079948):https://cordis.europa.eu/project/id/101079948; BuildON (Affordable and digital solutions to Build the next generatiON of smart EU buildings, Grant Agreement n. 101104141): https://cordis.europa.eu/project/id/101104141/it

list has been adapted and updated considering the specificities of the RETIME project. It includes relevant activities at different level of the SEOF to engage both stakeholders and end-users in the co-design and co-creation of the different parts of the solutions.

Table 7. List of potential RETIME co-design activities.

Activity	Design Thinking stage(s)	Engagement level	Brief description
Community Day	All	Inform Consult Involve	A community day brings community members together for an info-day, a day of celebration, engagement, and participation. It is typically held in a central location such as a public square or garden, community centre, or town square and is open to all residents and community stakeholders. During a community day, various activities are organised to cater to different interests and age groups. These may include live performances, cultural displays, arts and crafts booths, sports tournaments, educational workshops, food vendors, and interactive games for children and families. The event may also feature informational booths or exhibits from a specific project to showcase solutions and get fast feedback.
Open House	Prototype Test	Inform Consult	An 'open house' event is an informal engagement format that enables the public to freely visit and learn about a specific project or policy. These events are often held in accessible public locations where information related to the project can be displayed. Community members can ask questions, discuss issues, and provide fast feedback.
Community Walkshop	All	Consult Involve	Walkshops consist of walking tours of residents used to engage people in their neighbourhoods. Participants walk with a guide and discuss about challenges and opportunities. It combines elements of a walk (physical exploration) and a workshop (discussion and collaboration) to engage participants in a meaningful dialogue about the changes that a project can bring to their community.
Buzz Groups	All	Consult Involve	Buzz Groups are a quick way to gather feedback or responses during a plenary session. Without leaving their seats, participants form small clusters of two or three to briefly discuss a given question. This approach brings energy and variety to large group meeting.

Public Meeting	All	Inform Consult Involve	Public meetings bring diverse groups of stakeholders together for a specific purpose. Public meetings are held to engage a wide audience in information sharing and discussion. They can be used to increase awareness of an issue or part of a project, and can be a starting point for, or an ongoing means of engaging, further public involvement.
Discussion Forum	All	Consult Involve	It is an online platform where individuals from different locations can engage in conversations, exchange information, and collaborate based on shared interests or project-specific contexts, enabling effective communication and knowledge sharing.
Online Jam	Ideate Prototype Test	Collaborate	An online jam engagement refers to a collaborative and interactive event conducted virtually where participants engage in a creative or problem-solving process together. It involves individuals or groups coming together online to brainstorm ideas, share insights, and work collaboratively on a specific topic or challenge. Online jam boards are prepared in advance and then used for visual collaboration.
Innovation Challenge	Ideate Prototype Test	Collaborate Empower	Structured practice to analyse specific topics, get hands-on experience on practical cases and incorporate stakeholders'/experts' opinions. This 'game-style' format creates high levels of engagement and a strong culture of Innovation. It complements continuous innovation and keeps innovation in people's minds. It links innovation to strategy by providing solutions to topics of strategic importance. It deepens participants' understanding of the strategy when they work on the topic.
World Café	All	Consult Involve Collaborate	This informal café setting allows for more relaxed and open conversations. It is beneficial when you want to explore a topic from multiple perspectives to ensure that everyone in a room contributes to a conversation and/or when you want to encourage participants to make new connections. A group of stakeholders get together and set the agenda and the basis for assessment within a problem area. World Café questions are designed to begin at a general level and then to move toward more specific questions with each group rotation. This method supports participants in exploring an issue by discussing it in small groups of 4-8 persons per table. This type of workshop is a multi-stage process, enabling a 'host' (for each table) who stays at the table during the entire event and keeps the table discussion on task.

Envisioning the Future	Ideate Prototype Test	Involve Collaborate Empower	Envisioning the future is a scenario-building method, usually adopted in foresight events that invites collective reflection about plausible futures. It works by imagining a time in the future (three to six years ahead) and assumes that a project or policy has achieved important goals.
Charrette	Ideate Prototype	Collaborate	The Charrette engagement is a collaborative design process where stakeholders, experts, and community members come together to develop solutions for a project. It involves interactive workshops and design sessions held over a short period to encourage participation and generate consensus. The outcome is a detailed plan reflecting input from all participants.
Gamification	Prototype Test	Involve Collaborate	Gamification strategies employ various techniques to engage participants by incorporating game-like elements into non-game contexts. These strategies often utilize rewards to incentivise players who successfully complete desired tasks or foster competition among participants. One approach to gamification is to transform existing tasks into more game-like experiences using several effective techniques, such as incorporating meaningful choices for players, providing a comprehensive onboarding process with tutorials, introducing progressively challenging levels or tasks, and integrating narrative elements into the experience.
Stakeholder Working Groups	Prototype Test	Collaborate Empower	This method is designed as a workshop that enables focused discussions between different groups of stakeholders. This method consists of five steps (information, selecting a topic, discussion, deliberation, and vote), of which some can be repeated if more than one research scenario is to be enriched by each group.
Community Mapping	Ideate Prototype Test	Consult Involve	A community map helps local people engage in a project by highlighting their sense of boundary space. It can be a useful exercise to develop communication and increase knowledge of local environments. This method involves the systematic collection, visualisation, and analysis of data and information about a specific community or geographic area

VIPP Cards Collection Clustering	Define Ideate Prototype	Involve Collaborate	VIPP (Visualisation in Participatory Programmes) Card Collection and Clustering is a facilitated process that involves the use of cards to quickly gather and organize ideas from a group of people. It is especially useful in situations where you expect to get a diverse range of answers or inputs, or for addressing potentially sensitive issues in a way that is both safe and equitable.
Fishbowl	All	Consult Involve	The fishbowl technique is used to manage group discussions. A Fishbowl conversation is a form of dialogue that can be used when discussing a topic within large groups. Best used in conferences and workshops, this technique focuses the attention of the whole group on a discussion among 3-6 people. Other people present become observers, active listeners, and potential participants through a rotation process, which reduces the distance between speaker and audience.
Six Thinking Hats	All	Consult Involve Collaborate	The Six Thinking Hats method, developed by de Bono (1985), is a structured approach to group thinking and decision-making. It involves assigning different 'hats' to participants, each representing a specific thinking perspective. Participants take turns wearing each hat, guiding their thinking and contributions during specific phases of the discussion. This structured approach encourages diverse perspectives, fosters focused thinking, and enhances collaborative decision-making within a group setting.
Briefings	All	Inform Consult	This method is based on giving short presentations to community groups at their normal meetings or spaces. The presentation should provide an overview or update of the project and should be followed by an open discussion in a question-and-answer format. Briefings can act as a space for feedback, offering potential early insights into needs and concerns of targeted stakeholders.
Wants and needs analysis	All	Consult Involve	This method is a hybrid of focus group and brainstorming techniques, focused on gathering user requirements from multiple people at the same time. At first, a brainstorming conversation is facilitated, and then a prioritisation step allows to identify the most important requirements emerged during the brainstorming. As in focus groups, a preliminary preparation is needed to identify the most important information targeted and to prepare the questions to prompt the conversation.
Empathy Maps	Emphatize	Consult Involve	Empathy maps are useful to gather different perspectives on specific target group during and after focus groups, in-depth interviews, and user research. This tool allows to identify in a single canvas different emotions, feelings,

			and perception that a user can give referring to a use cases, usability of products and services, perceptions on a specific situation, before he has seen any kind of prototype.
Value Proposition Canvas	Ideate	Involve Collaborate	This canvas is useful to define the main characteristics of a product and/or service after user research has been conducted. It defines the main expectations (jobs to be done), painful alerts (pains) and wow moment (gains) in the interaction of a specific user with a given tool, solution, service, organisation. This is a part of the Business Model Canvas, and it is used to define the Unique Value Proposition.
User journey	Ideate Prototype	Consult Involve Collaborate	This tool is often used in service design to identify the different steps of user interaction, through a visualisation of a timeline, other users active in the interactions, specific touchpoints with which the user interact and the back-end part of the solution and the organisation that is developing it.

A disclaimer should be provided in advance, before undertaking the activities: this list is a starting point. It has been developed based on the current level of knowledge and skills of Local Desk Members. LDM will organise and implement engagement activities at local level throughout the project. The strategy and roadmaps included in this report should be accompanied by a capacity building process during the implementation of task T2.3 from April 2025 (M12) to October 2027 (M42). If other relevant activities, methods, and tools will be found throughout the project, they will be used and adapted to RETIME and described in the *D2.3 - RETIME Stakeholder engagement strategy*.

4.2.2. Role of Local Desk Members in Co-Design of Local Communication Campaigns

Local Desk Members play a key role in supporting co-created engagement activities with corresponding Communication and Dissemination (C&D) efforts. They will liaise with ICONS, the project's C&D leader, to co-create appropriate strategies and tools to ensure local representation of the RETIME project. As also outlined in *D6.1 - Communication, Dissemination, and Exploitation Plan Part 1*, Local Desks should:

- Organise local activities throughout the project, including cultural events, scientific conferences, RETIME-focused workshops, info-days, and sessions.
- Lead local engagement with citizens and stakeholders, implement the co-designed promotional campaigns. These campaigns, developed through internal workshops, should increase awareness of solutions for extreme weather and natural disasters.
- Populate the stakeholder database from ISCTE (under tasks T2.1 and T2.3), supporting socio-economic analysis, stakeholder mapping, and identification of vulnerable groups.
- Share project content locally and boost outreach through social media, networks, local press, and partner websites.
- Provide localised content to ICONS for EU-wide dissemination.
- Track local C&D efforts (e.g., events, press, videos, flyers) and report via ICONS-provided monitoring templates.
- Review and validate pilot site content for the project website.
- Translate key materials (e.g., press releases, social posts) into the local official languages of RETIME pilot areas.

5. Assessment of RETIME engagement performance

The performance of each engagement and co-design activity will be measured through a set of quali-quantitative social KPIs, such as number of participants, gender and type of stakeholder or target group, presence of vulnerable groups, level of engagement. Other KPIs based on RETIME engagement objectives cover general outreach, engagement and participants' perceptions and evaluations via short surveys and feedback forms. The analysis of these KPIs will support fine-tuning of the engagement strategy within task *T2.3 - Implementation and coordination of the stakeholder engagement strategy*.

Data will be collected through a Data Collection Template (DCT). The DCT (Annex C, Table 8) is an excel file containing one tab for each pilot. The DCT is accompanied by a guide on how to report engagement activities from both a quantitative and qualitative point of view. It includes a general description of each KPI and how to collect relevant data for each activity. The DCT will include the following information:

- Year, date, and venue of the activity
- Objectives of the activity
- Type of activity
- Description of the activity
- Level of engagement for each activity
- Total number of people involved in the activity
- Number of people for each stakeholder group involved in the activity
- Gender representation within the target groups participating in the activity
- Number of vulnerable people involved in the activity

Besides this, a Narrative Template (Annex D, Table 9) outlines specific information on the qualitative results of each activity. This template provides fields to record relevant interaction details after each activity.

6. Final remarks and next steps

The Social Innovation Roadmap is a living document designed to support the monitoring of engagement strategies in complex projects. In the RETIME project, a set of variables will be defined to guide both the concept and deployment of project solutions over time. By considering social, behavioural, and usability aspects, these variables will inform the deployment of TRL-related parameters.

Due to the complexity and diversity of RETIME pilot sites, engagement strategies will need to remain flexible and adaptable to the different context. This is why a flexible roadmap incorporating a range of possible engagement and co-design activities has been designed so far. Throughout the project implementation and monitoring phases, periodic updates of the Power-Interest Matrix and of the Social Innovation Roadmap will help to ensure that any changes in the project engagement strategy are addressed as effectively as possible.

As detailed in this report, the Sendai Framework serves as a guide for designing such flexible roadmap by aligning with national and European strategies to engage stakeholders in the definition of pilot-based Disaster Risk and Resilience strategies. This is achieved through the implementation of inclusive and co-designed solutions that are tailored to the specific context of each RETIME pilot site.

List of References

Bammer, G. (2021). *Stakeholder engagement primer: 4. Options for engagement*. https://i2insights.org/2021/11/04/options-for-engagement/

Bruine de Bruin, W., & Bostrom, A. (2013). Assessing what to address in science communication. Proceedings of the National Academy of Sciences, 110 (Supplement 3), 14062-14068.

Connnell, B., Jones, M., Mace, R., Mueller, J., Mullick, A., Ostroff, E., Sanford, J., Steinfeld, E., Story, M., & Vanderheiden, G. (1997). *The principles of universal design: Version 2.0*. The Center for Universal Design.

Coppola D.P. (2015). *Introduction to International Disaster Management* (3rd ed.). Elsevier/ Butterworth-Hein. www.loc.gov/catdir/enhancements/ fy1606/2014955858-d.html.

Council of the European Union. (2016). *Programme of the Slovak Presidency in the field of Civil Protection* (Document No. ST-10769-2016-INIT). https://data.consilium.europa.eu/doc/document/ST-10769-2016-INIT/en/pdf

Courage, C., & Baxter, K. (2005). *Understanding your users: A practical guide to user requirements methods, tools, and techniques*. Gulf Professional Publishing.

Cronstedt, M. (2002). Prevention, preparedness, response, recovery-an outdated concept? *Australian Journal of Emergency Management, 17*(2), 10-13.

Dam, R. F. (2025, March 13). The 5 Stages in the Design Thinking Process. *Interaction Design Foundation - IxDF*. https://www.interaction-design.org/literature/article/5-stages-in-the-design-thinking-process

De Bono, E. (1985). *Six thinking hats: An essential approach to business management*. Little, Brown and Company.

Design Council. (2005). *The design process: What is the framework for innovation?* Design Council. https://www.designcouncil.org.uk/resources/guide/design-process-what-framework-innovation/

Design Council UK. (2005). *The Design Process*. <http://www.designcouncil.org.uk/about-design/How-designers-work/The-design-process/%3E.

Design Council. (2019). The double diamond: A universally accepted depiction of the design process. Design Council. https://www.designcouncil.org.uk/our-work/news-opinion/double-diamond-universally-accepted-depiction-design-process/

Design Kit, I. D. E. O. (2016). *The field guide to human centered design*.

Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services.

Eppler, M. J., & Aeschimann, M. (2009). A systematic framework for risk visualization in risk management and communication. *Risk Management*, 11, 67-89.

EU (2019). *Inclusivity Act – Directive (EU) 2019/882 of the European Parliament and of the Council of 17 April 2019 on the accessibility requirements for products and services*. https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32019L0882

FEMA. (2024). *National Disaster Recovery Framework*. Federal Emergency Management Agency. https://www.fema.gov/national-disaster-recovery-framework

Gjøsæter, T., Radianti, J., & Chen, W. (2021). Universal design of ICT for emergency management from stakeholders' perspective: A systematic literature review. *Information Systems Frontiers*, *23*(5), 1213-1225.

Goniewicz, K., & Burkle Jr, F. M. (2019). Challenges in implementing Sendai framework for disaster risk reduction in Poland. *International journal of environmental research and public health*, *16*(14), 2574.

Granderson, A. A. (2014). Making sense of climate change risks and responses at the community level: A cultural-political lens. Climate Risk Management, 3, 55-64.

Granville, F., Mehta, A., & Pike, S. (2016). Destinations, disasters and public relations: Stakeholder engagement in multi-phase disaster management. *Journal of Hospitality and Tourism Management*, 28, 73-79.

Hasso Plattner Institute of Design at Stanford. (2010). *An introduction to design thinking: Process guide*. Stanford University. https://dschool.stanford.edu/resources

IDEO. (2009). *Human-Centered Design Toolkit: An open-source toolkit to inspire new solutions in the developing world* (1st ed.). IDEO.

Jernberg, N., Gąciarz, J., Martynenko, A., & Goldie-Ryder, K. (2019). *The Sendai framework in the Baltic Sea Region*. Council of the Baltic Sea States (CBSS), Secretariat for the CASCADE project.https://www.cascade-bsr.eu/sites/cascade-bsr/files/outputs/the_sendai_framework_in_the_baltic_sea_region_0.pdf

Mace, R. (1985). *Universal Design. Barrier-Free Environments for Everyone. Designers West*, *33*(1), 147-152.

Michal, T., Šimák, L., Ristvej, J., Benedik, V., Moricová, V., Sedliaková, M., ... & Brezina, D. (2019). Civil protection in slovak republic and society preparedness for crisis events. *Security & Future*, *3*(3), 75-78.

Morelli, A., Taramelli, A., Bozzeda, F., Valentini, E., Colangelo, M. A., & Cueto, Y. R. (2021). The disaster resilience assessment of coastal areas: A method for improving the stakeholders' participation. *Ocean & Coastal Management*, 214, 105867.

Phua, C.C. R. (2023). *Policy Strategy and Innovation Primer: Process, Praxis and Tools*. Routledge.

Ronoh, S. (2017). Disability through an inclusive lens: Disaster risk reduction in schools. *Disaster Prevention and Management: An International Journal*, 26(1), 105-119.

Ryan, B., Johnston, K. A., Taylor, M., & McAndrew, R. (2020). Community engagement for disaster preparedness: A systematic literature review. *International Journal of Disaster Risk Reduction*, 49, 101655.

Stough, L. M., & Kang, D. (2015). The Sendai framework for disaster risk reduction and persons with disabilities. *International Journal of Disaster Risk Science*, 6, 140-149.

Tariq, H., Pathirage, C., & Fernando, T. (2021). Measuring community disaster resilience at local levels: An adaptable resilience framework. *International Journal of Disaster Risk Reduction*, 62, 102358.

Telhado, M.J., Morais, M., Cardoso, M.A., Brito, R.S., Pereira, C., Lopes, R., Barreiro, J., Pimentel, N., Silva, I.C., Duarte, N., Almeida, M.C. (2020). Lisbon Resilience Action Plan. In *Resilience Action Plans of the RESCCUE cities*.

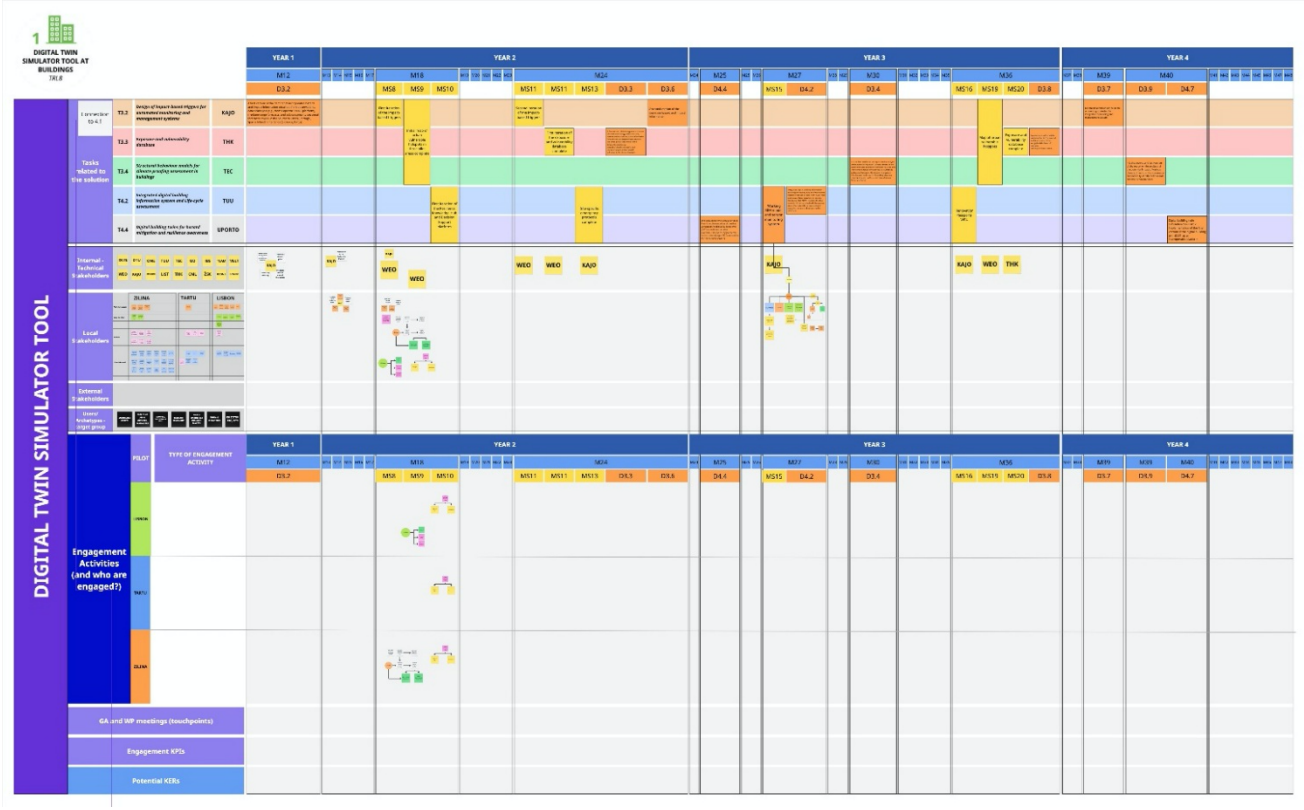
Twomlow, A., Grainger, S., Cieslik, K., Paul, J. D., & Buytaert, W. (2022). A user-centred design framework for disaster risk visualisation. *International Journal of Disaster Risk Reduction*, 77, 103067.

United Nations Office for Disaster Risk Reduction. (2015). *Sendai Framework for Disaster Risk Reduction 2015-2030*. https://www.undrr.org/publication/sendai-framework-disaster-risk-reduction-2015-2030

Villeneuve, M. (2021). Building a roadmap for inclusive disaster risk reduction in Australian communities. *Progress in Disaster Science*, 10, 100166.

Wohlin, C., Kalinowski, M., Romero Felizardo, K., & Mendes, E. (2022). Successful combination of database search and snowballing for identification of primary studies in systematic literature studies. *Information and Software Technology*, 147.

Annex A: RETIME Miro Board Template



Annex B: RETIME Social Innovation Roadmap Template

								Timeline	M12			M13	M14	M15	M16	M17	M18			
									Apr			May	Jun	Jul	Aug	Sep	Oct			
Touchpoints	Project meetings								GA2											
	Milestones								MS6	MS7								MS8	MS9	MS10
	Deliverables								D1.3	D2.2	D3.2	D1.2				D7.6	D1.5		D3.1	D4.6
Solution	Engagement objectives	Engagement activity (Description list in D2.2)	Engagement level						First iteration on data specification requirements	Stakeholder maps								First iteration on impact based triggers	Initial map of vulnerable hotspots	First iteration of Resilience Hub and DSS
			Inform	Consult	Involve	Collaborate	Empower		Data Specification Requirements Part 1	Stakeholder engagement roadmaps	Impact-based triggers for alert monytoring Part 1	Report on existing long-term resilience stragies in pilots				PMP and WBS PArt 2	Data Specification Requirements Part 2		Map of vulnerable hotspots in pilots Part 1	Resilience Hub and DSS platform Part 1
Sensor-based IT automated alert system	Informing on the alert system	Public Meeting	X	X																
	Defining specific requirements for interfaces and triggers	Wants and needs analysis		X																
	Getting feedbacks	Feedback loops		X	X															
Digital Twins	Co-design of the DT system	Prototyping workshop																		
	Getting feedbacks	Public Meeting																		
Resilience Hub and Decision Support System	Co-design buidling resilience indicators	Briefing																		
	Leveraging on citizen science activities to make the Resilience Hub an easy-to-use tool for decision makers	User journeys			X	X														
	Leveraging on citizen science activities to make the Resilience Hub an easy-to-use tool for decision makers	Prototyping workshop																		
	Co-design emergency protocols considering bulding occupants, Know occupancy patterns	User journeys		X	X	X														
Digital Building Renovation Passport	Engaging technical stakeholders in the definition of the tool	Buzz Groups				X														
Sustainable business models	Engaging relevant stakeholders in the definition of the business models	Value Proposition Canvas Workshop		X	X	X														
Ideathons	Definition of the challenges for the local ideathons	Innovation Challenge			X	X	X													
Resilience Games	Co-design of the resilience games	Gamification			X	X														

Legend	
	Proposed activity
	Change in the proposed activity
	Proposed activity completed
	Proposed activity not done

Annex C: RETIME Data Collection Template

Table 7. Data Collection Template.

Date	Venue	Objectives	Type of activity (D2.2 list)	Description of the activity	Engagement level *(mark with an X)*					Total number of people involved	Stakeholders involved *(number for each target group)*								Gender balance		Vulnerable groups engaged (number of people defined as vulnerable target groups in RETIME)
					Inform	Consult	Involve	Collaborate	Empower		Building occupants	Building representatives	NGOs and local associations	Public Authorities	Other institutions	SMEs	Universities	Research Institutions	Male	Female	

Annex D: RETIME Narrative Template

Table 8. Community Engagement Narrative Report Template.

RETIME Solution(s)	Please describe the specific part of the solution that has been tested through the activity. **Example:** Co-design of impact-based triggers
Engagement activity	Please describe the engagement activity implemented and how the activity has been organised. **Example:** The requirements will be defined through method XY. The activity was held at the Association's venues.
Adherence to initial objectives	Please describe if the purpose of the engagement activity corresponds to the initial objectives defined in the engagement roadmap. **Example:** Gathering requirements for the implementation of a specific solution
Outcomes of the engagement activity	Please briefly describe the outcomes of the engagement activity
Integration of outcomes	Please describe how the outcomes of the engagement activity will be integrated into the development of RETIME solutions. **Example:** The outcome of the wants and needs analysis will be firstly analysed by pilot leaders with the objective of defining the final requirements for the user interface of solution XY. Finally, this data will be sent to developers, who will do a feasibility check and will eventually update the interface according to the insights collected through the wants and needs analysis.
Timing for integration of outcomes	Please describe the timing of the integration process of the outcomes of the engagement activities. **Example:** The outcome will be integrated to the co-design process at M12, after the definition of technical features by developers at M09.