A KNOWLEDGE CAPSULE ON **STAKEHOLDER ENGAGEMENT**

The Water Economy example

Funded by the European Union

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Editorial

In pursuing a sustainable future, a circular economy has emerged as a pivotal framework, particularly within water management. The CIRSEAU cluster, an alliance of **EU-funded research projects**, has been at the forefront of this movement. The projects designed a set of innovative tools, games, and applications to foster stakeholder involvement and promote sustainable water practices. These were demonstrated at the **Making waves: Tools and games for stakeholder engagement on water, sustainability and the circular economy** on 5 July 2024 as part of the **Ecsite Conference** in Ljubljana, Slovenia. The workshop was jointly organised by the CIRSEAU Cluster working groups on stakeholder engagement and communication.

This knowledge capsule consolidates these resources, providing a **comprehensive toolkit for policymakers, researchers, and practitioners**. The capsule includes an overview of each project, detailed descriptions of the tools and applications developed, and findings from these initiatives.

It is important to emphasise that the tools and applications are designed to be adaptable and should be employed in other contexts where stakeholder engagement is a priority.

Overview of projects and the Circular Water Economy

Five sister projects were granted within the H2020 call topic CE-SC5-04-2019 entitled “Building a water-smart economy and society”. This call was targeting actions able to demonstrate **the feasibility of a 'water smart' economy and society** in which all available water resources, including surface, groundwater, wastewater, and process water, are managed in such a way as to avoid water scarcity and pollution, increase resilience to climate change, appropriately manage water-related risks, and ensure that all valuable substances that could be obtained from wastewater treatment processes, or are embedded in used water streams, are recovered.

Project 1: B.WATERSMART

B-WaterSmart, Accelerating Water Smartness in Coastal Europe (GA No: 869171), accelerates the transformation to water-smart economies and societies in coastal Europe and beyond. A water-smart economy and society are geared towards avoiding water scarcity and pollution, increasing resilience to climate change, and managing water-related risks. The EU-funded B-WaterSmart project aims to speed up the transition to water-smart economies and societies in coastal Europe and beyond. To achieve this, it will adopt a large-scale systemic innovation approach to select, connect, and demonstrate tailored solutions for multiple users and sectors. It will further create new business models based on circular economy and water-smartness. The project will deliver a new framework for evaluating gains in water-smartness and sustainability at different scales. It will also demonstrate a range of promising technologies for water reuse and nutrient recovery and smart data applications for more efficient resource allocation and use. More information about the project can be found at the project website (https://b-watersmart.eu/)

Project 2: REWAISE

As water is vital to sustaining life, the **REWAISE** project, REsilient WAter Innovation for Smart Economy (GA No: 869496), creates a new smart water ecosystem, embracing the true value of water and paving the way for a resilient circular economy. New business niches will incentivize water-related investments and accelerate SME growth. By linking users with specific water needs and collective actions, new governance frameworks will generate high social returns, maximising value in water (putting to beneficial use dissolved substances such as nutrients, minerals, chemicals, and metals, as well as organic matter and energy, embedded in water streams), value from water (enhancing activities inherent to the water cycle, products and services that generate benefits and jobs) and value through water (fostering societal and well-being functions of water, while minimising emissions). More information about the project can be found at the project website (https://rewaise.eu/)

Project 3: ULTIMATE

Water smart industrial symbiosis. Wastewater can act as a reusable resource as well as a vector for energy and materials to be extracted, treated, stored and reused. The EU-funded **ULTIMATE** project, indUstry water-utiLiTy symbIosis for a sMarter wATer society (GA No: 869318) will operate as a catalyst for Water Smart Industrial Symbiosis (WSIS), in which water/wastewater plays a key role within a dynamic socio-economic and business-oriented industrial ecosystem. ULTIMATE will demonstrate the multiple uses of municipal and industrial wastewater through nine high-level demonstrations in Europe and the south-eastern Mediterranean from the agro-food processing, beverage, heavy chemical/petrochemical, and biotech industries. It will recover, treat, and reuse industrial and municipal wastewater, derive and exploit energy, and extract valuable materials contained in industrial wastewater. It will also advance innovative collaborations between businesses, water service providers, regulators, and policymakers for a more circular and socially responsible industry. More information about the project can be found on the project website. (https://ultimatewater.eu/)

Project 4: WATER-MINING

Mining water & resources from desalination brines urban & industrial wastewater streams. Water security is among the most crucial challenges for water management today. As a consequence, innovative water management solutions and alternative water resources are required. The EU-funded **WATER-MINING** project, Next generation water-smart management systems: large scale demonstrations for a circular economy and society (GA No: 869474), will exhibit and validate innovative next-generation water resource solutions at the pre-commercial demonstration scale following relevant legislation, such as the Water Framework Directive, Circular Economy, and EU Green Deal packages. It will combine water management services with improving renewable resources such as mining water. It is envisaged that the value-added end products will offer supplies of regional resources to increase economic growth. The project will examine different designs proposed for urban wastewater treatment and seawater desalination and innovative service-based business models aiming to improve the engagement of private and public stakeholders. More information about the project can be found on the project website. (https://watermining.eu/)

TOOLS

Accessibility Databases
Tool 1: UWC observatory

The Lisbon Urban Water Cycle Observatory is a data visualization instrument to monitor and communicate performance and support urban planning and decision-making. Following the motto “to know so to reduce”, the Observatory is integrated into the scope of Lisbon city's sustainability policies, covering water and wastewater dimensions, as well as the environmental dimensions of the city, namely energy consumption, urban waste, greenhouse gases (GHG) emissions and mobility. This Observatory includes two complementary tools:

- A public access tool, with open data information on the water and wastewater city dimensions (top-down approach)
- A private access tool, for individual entities to integrate and analyse, via a set of analytics, the water consumption data of their facilities (bottom-up approach)

Public access privileges the use of infographics providing information on the city's water matrix on an annual basis regarding main water flows, consumption disaggregation by type of water source, by type of use and by type of user, per capita indicators, amount of treated wastewater and reclaimed water production. This data set allows citizens and city stakeholders to be informed, to know their impact, and feel motivated to participate and act towards increasing efficiency, assessing the impact of implemented policies, monitoring the benefits of behaviour changes, and, consequently, continue to move towards the necessary change. The private access is aimed at single entities that access the UWC Observatory upon request and whose facilities have water metering reported in digital data. This allows visualization of aggregated consumptions and costs per typology of water use (e.g. gardens, administrative services, schools, markets, museums) and type of water source (potable water, reclaimed, groundwater, and spring water), water consumption evolution, and individual consumption analysis, leading to insightful water management, also based on data analytics and automatic performance reports.
Link: https://b-watersmart.eu/the-urban-water-cycle-observatory/

Whom it serves

The UWC Observatory faces the upcoming challenges of sustainable water use, which must be tackled as soon as possible to improve the “water smartness for responsible consumers”.

The tool's end users are slightly different for each access. The Public access end users are **citizens, municipalities, politicians, decision-makers, urban management authorities, academia, researchers, NGOs, media, and other key stakeholders**.

For private access, the end users are mainly **municipalities, local administration, private institutions of public interest, and entities with high water use and/or a large number of water meters**.

TOOLS

Decision Support Tools
Tool 2: Dashboard

The B-WaterSmart dashboard is a web application, which utilizes the B-WaterSmart Assessment Framework to aid decision-makers in the water sector with strategic planning, aiming to evaluate progress towards a water-smart society

As a public deliverable of the B-WaterSmart project, anyone interested can register and use the tool.

Link: https://bws-dashboard.iccs.gr
Username: iccs
Password: iccsBWS

Whom it serves

The tool assists **regional decision-makers, authorities, researchers, and consultants** in strategically managing water systems. It can be used 1) to support strategic planning, 2) to enable overcoming barriers in implementing strategic agendas for water smart societies and 3) to facilitate benchmarking by delivering a set of metrics accompanied by reference values. In the final version of the tool, all the required steps of the strategic planning process are implemented, namely Step 1 – Selection of strategic objectives, assessment criteria, metrics, and reference values, Step 2 – Diagnosis, including scenarios creation, Step 3 - Set the targets, Step 4 – Develop the strategic plan, Step 5 - Implement the strategic plan, Step 6 - Monitor performance.

The tool was developed and tested as part of the Innovation Alliance, a joint activity for co-creation and co-learning. Direct testing by representatives of the target audience helped to improve the tool already during the project duration; for example, significant modifications were made to the UI design to better match the user's expectations.

TOOLS

Living Labs
Tool 3: Water LLs

Since the emergence of the **Living Lab concept** in the 1980s, many interpretations have been posed about its definition. Within the REWAISE and WATER MINING project, we used the definition of a Living Lab provided by ENoLL (European Network of Living Labs).
Link: https://rewaise.eu/living-labs/

Whom it serves

According to ENNOLL, the concept 'Living Lab' is used for the **organisation that innovates according to these principles**, but also refers to the innovation projects that follow these guidelines and also links with specific activities, methods and tools within these innovation projects. Therefore, a distinction can be made between a **Living Lab organization**, a **Living Lab project** and **Living Lab activities**, methods and tools (micro, meso, macro).

Living labs are more than solution-driven; They are problem-driven, tackling wicked problems of society as a whole. Living Labs operate as intermediaries between all actors of the quadruple helix (citizens, government agencies, companies, and research organizations), focusing on interdisciplinary collaboration.

The quadruple helix model, as defined by Carayannis and Campbell in 2009, describes interactions between university, industry, government, and the public environment within a knowledge economy

ENoLL Living Labs are:

Open innovation ecosystems in real-life environments based on a systematic user co-creation approach that integrates research and innovation activities in communities and/ or multi-stakeholder environments, placing citizens and/or end-users at the centre of the innovation process.

Living Labs as real-life test and experimentation environments, foster co-creation and open innovation among the main actors of the Quadruple Helix Model.

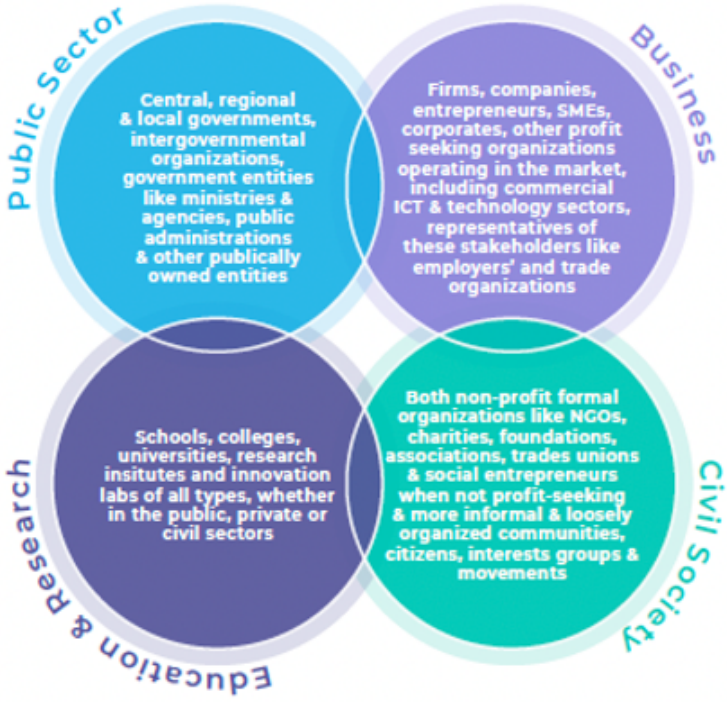

Figure 1. Quadruple helix model as presented in th e REWAISE handbook

Whom it serves

Water-oriented Living Labs facilitate interventions with a cross-sector nexus approach in real-world and/or realistic environments. In this context, they operate as proactive learning and innovation ecosystems with R&D continuity and reproducibility. Democratic control systems, with context-specific needs, support their open and local multi-stakeholder governance structures. One of the key concepts of a sustainable Living Lab is the three-layered model developed by Dimitri Schuurman in 2015. This model clearly distinguishes between three levels of a Living Lab: the macro-, meso-, and micro-levels.

- **On a macro-level**, a Living Lab is a public-private-people partnership consisting of different stakeholders, organised to carry out Living Lab research and projects. We refer to this level as the Living Lab constellation.

- **On the meso-level**, we discern the Living Lab innovation projects being carried out within the Living Lab constellation. We refer to these as Living Lab project(s).

- We label the (research) activities deployed in a Living Lab as **micro-level** activities in Living Labs. This consists of a specific Living Lab methodology to cultivate user-led insights and surface tacit, experiential, and domain-based knowledge so that it can be further codified and communicated.

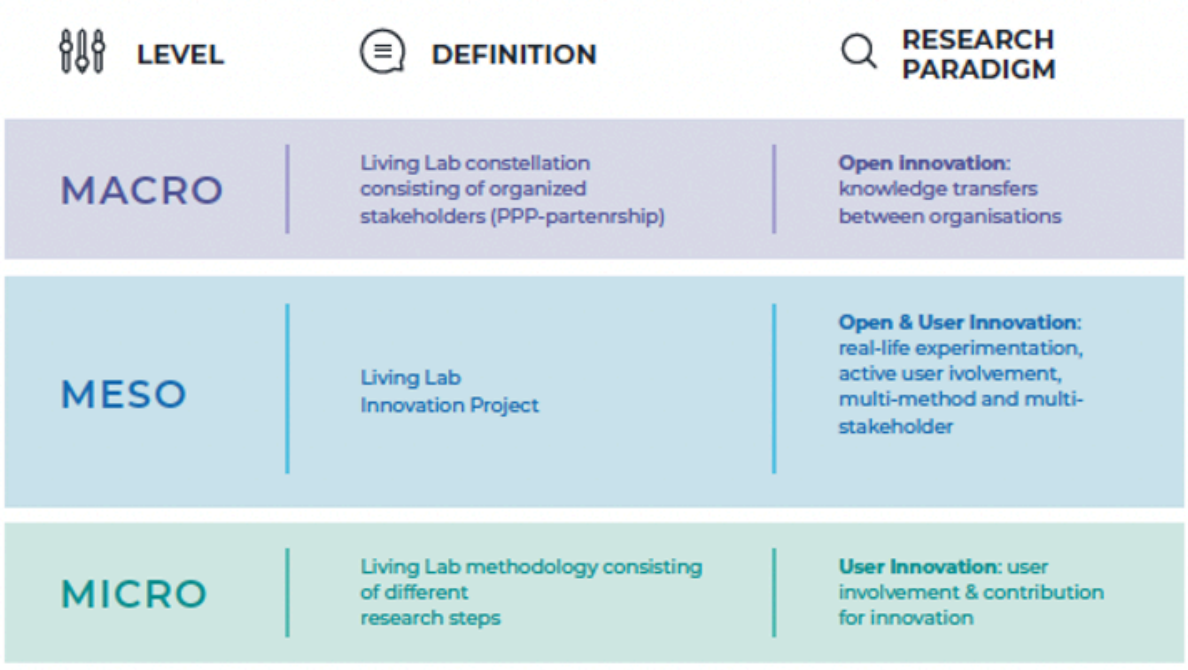

Figure 1b The three-layered model of a Living Lab, Schuurman (2015)

TOOLS

Reflective Communities Tool 4: Communities of practice

CoPs would be understood as social learning systems that bring together people from different backgrounds and perspectives, with different types of complementary knowledge and expertise, who share a concern to solve a particular problem and/or carry out a project for the development of particular technological innovations and learn how to do it better as they interact regularly.

In this perspective, the CoPs aim to address differences and tensions when different kinds of knowledge and expertise come together to collaboratively carry out participatory research for technological innovation. The CoPs also gather information to better grasp the complexity and promote social learning and empowerment.

Three Fundamental Elements of a CoP

Domain:
A CoP distinguishes from other networks since its members identify themselves by a shared domain of interest. Membership involves a commitment to the domain and a shared competence.

Community:
While showing their interest in their domain, community members share information, help each other and join activities and discussions. In this form of interaction, members build relationships in order to learn from each other and to support each other.

Practice:
Members of a CoP do not only share a common interest, they are engaged in common practice, as an iterative social process, where they develop a shared repertoire of resources. These can be experiences, stories, tools or ways of addressing recurring problems. To develop this kind of a shared practice it takes time and continuous interaction.

Whom they serve

Communities of Practice (CoPs) can support **professionals, practitioners, researchers, policymakers, and community members who share common goals, challenges, or aspirations**. CoPs are particularly valuable for groups seeking to co-create solutions, exchange best practices, and develop collective expertise. By providing a structured yet flexible environment, CoPs can empower participants to actively contribute, gain new perspectives, and address complex societal or organizational challenges. Their inclusive and participatory nature ensures that diverse viewpoints are integrated, ultimately enriching the community's shared purpose and outcomes.

TOOLS

CoPs and a context-sensitive design of technologies

WATER MINING implemented a “context-sensitive design” approach (Palmeros-Parada et al., 2023) to Case Studies (CSs), with a Responsible Innovation perspective (Marques Postal et al., 2020). These processes were developed using the CoPs as a space of discussion and knowledge exchange between project researchers and stakeholders.

Establishing a CoP

Establishing a Community of Practice (CoP) requires a structured yet flexible approach. Success depends on defining a clear vision, setting governance structures, and ensuring strong leadership. The CoP’s purpose, objectives, and decision-making processes should be established early, with a core team managing responsibilities and resources. Planned engagement activities encourage communication within the community and externally. Collaboration is key, focusing on co-creating knowledge and improving shared practices. Effective management ensures knowledge is visible, accessible, and actionable, while a measurement framework tracks progress and refines activities.

Building a participatory research community takes time. Initial meetings should focus on knowledge-sharing and identifying missing stakeholders. Clarity is essential, ensuring participants understand objectives, roles, and their influence on outcomes. Ongoing communication keeps stakeholders engaged, while existing participatory structures can be useful but may introduce biases. To ensure inclusivity, diverse perspectives should be actively integrated. Researchers should also reflect on their own biases and influence in participatory processes.

Successful implementation requires careful planning and facilitation. Stakeholders should receive key information in advance, and meetings should allow time for discussion and networking. Accessible venues and effective facilitation encourage participation. Meetings should conclude with a summary and follow-up. Social research methods help bridge communication, and technical partners should receive training or involve skilled facilitators.

Link:
https://cordis.europa.eu/project/id/869474/results

TOOLS

Serious Games
Tool 5: PlayDecide Game

The WATER-MINING PlayDecide Card Game is designed for simple, respectful & fact-based group discussion and decision-making. There is also a shorter (crash) version of the game to spark discussions on water scarcity issues in Europe. This version is ideal for young learners (14-18 years) and crash sessions. A PlayDecide session lasts approximately 45 (crash version) to 90 minutes (full version). The ideal number of players is 4 to 6. You need to set up several parallel groups if there are more than 6 players. The link below contains all the necessary elements for a group of up to 6 people. The game needs a facilitator who takes the time to get familiar with the flow and contents of the game before playing.

The games have been translated into Greek, Spanish and Dutch.

Purpose

The game enables players to familiarize themselves with a question, consider different perspectives, and form or clarify an opinion. PlayDecide also invites players to consider issues as a group: can you reach a positive consensus? Participating in a PlayDecide game allows people to respond intuitively to the information presented and, through the resulting discussions, explore their reasoning and the values behind their choices. No speakers or experts are needed as the prepared cards contain all the necessary information. At the heart of the game are four policy positions on wastewater treatment, seawater desalination, the circular economy, sustainability, and economic and environmental impact.

Whom it serves

The PlayDecide Games are perfect tools for the engagement of **different stakeholders** (groups of policy makers, citizens, industry representatives, community leaders, students) as well as excellent tools for discussion and engagement for younger audiences such as high school students. Their unique structure provides the opportunity to participants to gain new knowledge related to specific topics (health, environment, science etc), understand different points of view and policy implications.

Link: https://watermining.eu/play-decide-game/

TOOLS

Interactive digital tools
Tool 6: AR app

The AR application offers a comprehensive suite of functionalities designed to enhance user engagement and interaction. It allows for demonstrating AR campaigns featuring specific, targeted content, enabling users to visualize 3D content and animations seamlessly. Users can navigate to points of interest within campaigns, accessing relevant content effortlessly.

The application supports the creation of personalized profiles, tailoring the experience to individual preferences. Through the smartphone camera lens, users can explore their environment, utilizing markers, object detection, and localized campaigns to discover new information.

Additionally, the platform encourages user participation by allowing them to share feedback, ideas, and comments. Gamification features such as quizzes, leaderboards, a virtual agent, and helpful tips further enrich the user experience, making the exploration of AR content both informative and entertaining.
Link: https://watermining.eu/augmented-reality-app/

Whom it serves

The AR application caters to a diverse range of users, including **educators, students, sustainability advocates, and the general public**. It is designed for individuals and organizations interested in immersive learning experiences, particularly in areas like sustainable practices and water resource management. By providing engaging and interactive features, the app appeals to those seeking innovative ways to explore and promote circular economy principles, offering valuable tools for both personal education and community-driven initiatives.

How the app aids in circular water economy practices

The AR application significantly promotes circular water economy practices by providing **immersive and interactive educational experiences**. It visualizes complex processes such as water recycling, purification, and efficient usage through 3D animations, making these concepts more accessible and engaging for users. Using the smartphone camera, users can explore real-world water management systems enhanced with augmented reality markers and object detection, offering a deeper understanding of sustainable practices in their immediate environment. The app also facilitates navigation to water-related points of interest, providing valuable information on local water resources and initiatives. Personalized profiles allow users to track their learning progress and participation in water conservation activities. Additionally, the platform incorporates gamification elements like quizzes, leaderboards, and virtual agents, encouraging users to adopt and share sustainable water practices actively. Through user feedback and idea sharing, the AR application fosters a community-driven approach to water conservation, contributing to a more sustainable and circular water economy

TOOLS

Tool 7: Place by Design Playbook

A **Place by Design Playboo**k is a framework that provides guidelines for integrating stakeholder engagement activities into co-creation processes. It emphasizes inclusivity, adaptability, and iterative design and consists of 8 stages outlined in Figure 2.

The features and functionalities employed in the ULTIMATE project follow a multi-stage approach that integrates co-creation, community involvement, and innovation, supported by the framework and assisted at each stage with a set of tools.

This structured approach uses the Place by Design Playbook, a framework for engaging stakeholders in co-creation activities. The playbook emphasizes inclusivity, adaptability, and iterative design, ensuring that all stakeholders—whether community representatives, industry experts, or others—are involved in meaningful dialogue throughout the process.
Link:
https://ultimatewater.eu/stakeholder-engagement/playbook/

Whom it serves

The Place by Design Playbook serves a wide range of stakeholders by incorporating inclusivity and adaptability throughout co-creation processes. It engages **community representatives** to address local challenges with tailored solutions, **industry experts** to integrate practical knowledge and innovation, **citizens** to promote active participation and awareness, and **policymakers** to support sustainable decision-making.

By emphasizing iterative design, stakeholder feedback, and adaptive approaches, the playbook ensures that all participants can meaningfully contribute to and benefit from the design and implementation of solutions, particularly in areas like circular water economy practices.

TOOLS

How the app aids in circular water economy practices

Co-creation in circular water economy practices enables stakeholders **to collaboratively propose, discuss, and prototype solutions for pressing water management issues** (Kazadi et al., 2016). This process combines diverse ideas and resources to create value, addressing specific needs and fostering tailored service experiences. Co-creation engages stakeholders in open dialogue and reflection, helping to identify common ground and solutions that enhance community action, social engagement, and citizen involvement (Markovic and Bagherzadeh, 2018).

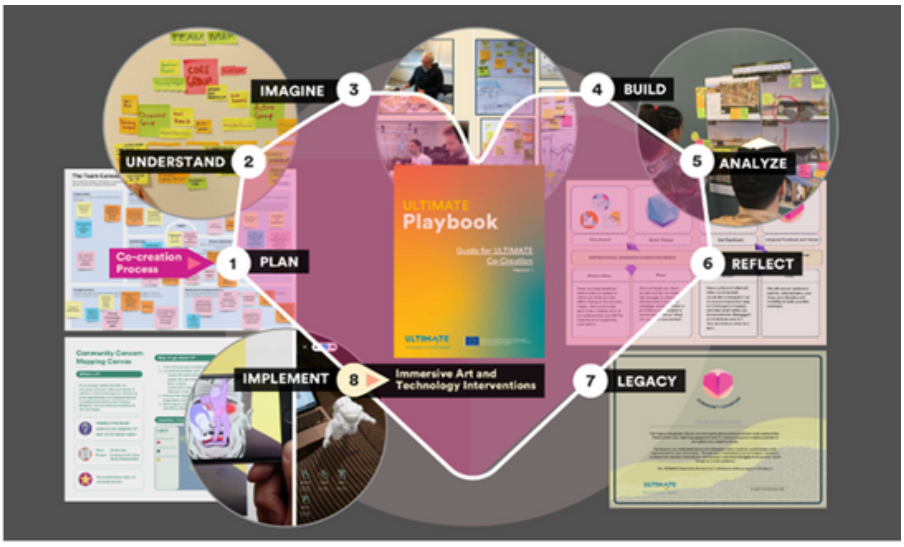

Figure 2: Co-creation framework using the Playbook

User feedback and success stories

In the ULTIMATE project, co-creation results **inform the development of Immersive Media Experiences (IMXs) used in three case studies)**. These immersive experiences use real-world data visualizations, location-based narratives, and gamification elements to engage stakeholders in understanding and solving water-related issues. By integrating storytelling with interactive technology, the IMXs promote active participation and enhance the understanding of complex concepts like water reuse and industrial symbiosis.

The IMX served as a core element in engaging stakeholders by providing immersive, interactive platforms designed through co-creation processes. These installations were implemented in three CSs, reflecting their unique contexts and maturity levels. For instance, at CS2 (KWR in the Netherlands), the IMX offered a location-based experience, utilizing QR codes for interaction with specific marker stands. At CS3 (Aretusa Wastewater Treatment in Rosignano, Italy), an interactive tabletop equipped with augmented reality (AR) markers and Kinect depth sensors created a hands-on exploration environment. At CS9 (Kalundborg, Denmark), a large-scale AR-enabled vinyl foam floor facilitated the visualization and understanding of industrial symbiosis and water reuse concepts. These installations were co-created with stakeholders to ensure relevance and usability, incorporating feedback from diverse participants throughout the design process.

CONCLUSION

The projects have delivered **a series of comprehensive tools for engaging stakeholders across different settings to advance circular water economy practices.** The tools presented here can be applied to various research areas beyond the water economy and various stakeholders across Europe. Among many conclusions three key insights emerge from these initiatives:

- The successful implementation of research practices requires **integrated stakeholder engagement**, as demonstrated through tools like the UWC Observatory, B-WaterSmart Dashboard, and Water-oriented Living Labs among others. Platforms enable data-driven decision-making while ensuring accessibility for diverse users, from policymakers to citizens.

- The projects show that **technological innovation must be paired with social engagement to be effective**. Tools like the PlayDecide game and AR applications bridge the gap between technical complexity and public understanding, making research concepts such as water management more accessible to various audiences.

- The importance of **adaptable, context-sensitive approaches** is evident across all projects, exemplified by the Place by Design Playbook and Living Lab frameworks. This flexibility enables solutions to be tailored to local needs while maintaining methodological rigor.

These tools collectively provide the foundation for **evidence-based policy-making**, **structured stakeholder engagement**, and **education** in various research and technological areas. Their success in combining innovation with social engagement offers a promising path toward achieving sustainability in Europe and beyond, while establishing a model for future circular economy initiatives.

water mining

ULTIMATE

REwaise
REsilient WAter Innovation for Smart Economy

B-WaterSmart

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