UNALAB ULL FRAMEWORK

D2.1 Deliverable

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Description of the related task and the deliverable. Extract from DoA	**T2.2 UNaLab Living Lab Framework and Principles (LTU) M1 – 36** A scientific UNaLab Living Lab framework will be developed for use by UNaLab front-runner cities as ULLs based on theories and practises for Living Lab and Action Design Research. This will include planning of the ULL training programme in T2.4 and implementation of ULLs in WP5. The framework ensures enhanced stakeholder and citizen ownership of solutions through effective, systematic involvement in co-design, co-development and co-implementation. The framework will build on existing ULL principles and best practices and will define a common implementation model for ULL environments including Key Components, Key Principles and Key Stakeholders. The framework will also include research approaches for citizen engagement, co-creation, design, test and evaluation in real world contexts with a focus on citizens participating as human actors in the smart city development rather than as factors mainly contributing with data. This task will output M2.1, D2.1 and D2.4.				
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About UNaLab

UNaLab will develop, via co-creation with stakeholders and implementation of 'living lab' demonstration areas, a robust evidence base and European framework of innovative, replicable, and locally-attuned nature-based solutions to enhance the climate and water resilience of cities. UNaLab focuses on urban ecological water management, accompanied with greening measures and innovative and inclusive urban design. The UNaLab partners aim to develop smarter, more inclusive, more resilient and more sustainable local societies through nature based innovation jointly created with and for stakeholders and citizens. UNaLab's 3 front runner cities: Tampere, Eindhoven and Genova, have a track record in smart and citizen driven solutions for sustainable development. They support 7 follower cities: Stavanger, Prague, Castellon, Cannes, Basaksehir, Hong Kong and Buenos Aires plus share experiences with observers as City of Guangzhou and the Brazilian network of Smart Cities. Therefore UNaLab results will impact on different urban socio-economic realities, with diversity in size, challenges and climate conditions. In order to create an EU reference demonstration and go-to-market environment for NBS, UNaLab will use and further develop the ENoLL Urban Living Lab model, and the European Awareness Scenario Workshop method for the co-creation of solutions, and the roadmap approach, in this way achieving an innovative NBS toolbox.

Task 2.2 Description

A scientific UNaLab Living Lab framework will be developed for use by UNaLab front-runner cities as ULLs based on theories and practices for Living Lab and Action Design Research. This will include planning of the ULL training programme in T2.4 and implementation of ULLs in WP5. The framework ensures enhanced stakeholder and citizen ownership of solutions through effective, systematic involvement in co-design, co-development and co-implementation. The framework will build on existing ULL principles and best practices and will define a common implementation model for ULL environments including Key Components, Key Principles and Key Stakeholders. The framework will also include research approaches for citizen engagement, co-creation, design, test and evaluation in real world contexts with a focus on citizens participating as human actors in the development of NBS, rather than as factors mainly contributing with data. Training material focused on how to set up and run a Living Lab will be developed (to be used in T2.4). The final output from this task is a Handbook for Establishing and Operating Urban Living Labs, which will be disseminated and exploited both within the project and beyond. The handbook will be developed in an iterative matter building on the experiences in UNaLab.

Partners

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1. EXECUTIVE SUMMARY

The aim of this deliverable is to present a scientific UNaLab Living Lab framework to be used by UNaLab front-runner cities. This framework is based on theories and practices for Living Labs, Action Design Research, methods for co-creation and data from workshops with the front-runner cities. Included in the framework is also the planning of the ULL training programme that will be performed in T2.4 and implemented in ULLs in WP5. Based on the theories, this deliverable provides insights into methods and approaches for ULL activities, taking its starting point in the research approaches for ULLs. Thereafter, a section supporting the definition of ULL and all its components and approaches is presented including templates and guidelines supporting the process of setting up and running an ULL. Thereafter, the results from a workshop carried out in the UNaLab project with both front-runner cities and follower cities are presented. This is followed by a description of the plan for ULL training program including a timeline for that process.

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2. INTRODUCTION

Opening up the innovation process by involving different stakeholders in innovation activities is important in today's increasingly open society spurred by open data, open science and open innovation (Chesbrough, 2006). Living Labs embody one approach to managing open processes, wherein different stakeholders including citizens are empowered to innovate through idea generation, co-creation, tests and evaluation in open, multi-contextual, collaborative, and real-world settings (Bergvall-Kareborn, Holst, & Stahlbrost, 2009). One context in which the integration of interests of citizens and other stakeholders with innovative experiences can be done is in urban settings such as city centers, neighborhoods, universities and local business communities. Within this approach, the whole city can be seen as a Living Lab focusing on long-term scaling of co-creating innovation; in Living Lab literature this concept is coined an Urban Living Lab (ULL).

Based on previous research there is still no unified definition of what can be considered an ULL. In addition, it is unclear what the objective of an ULL is, what challenges an ULL aims to solve, what exactly can be considered an urban context, and finally, who should be engaged in the innovation process and how. These questions show that there is a need for an ULL framework that clarifies its objective and work process. The UNaLab project will fulfil the present need to develop a framework that can support the development of ULL from a different perspective, and to identify and understand the key elements, objectives, challenges and characteristics of an ULL based on both theory and practice.

Current understanding of the ULL concept

In the UNaLab project, existing knowledge on ULLs forms the basis for the ongoing work. We will continue developing the framework based on experiences from the training sessions and the workshops with UNaLab cities.

The ULL concept originated and evolved from the Living Lab concept where the importance of cities and urban context as a real-life setting was highlighted in Living Lab research. This approach emerges from the development of smart cities as well as from the trend of engaging citizens in urban planning. In order to develop a research agenda on how the ULL concept is being operationalized in contemporary urban governance for sustainability and low carbon cities, Voytenko *et al.* (2016) conducted a literature review followed by five case studies of ULL projects. In their study, they identified five key ULL characteristics, namely: geographical embeddedness, experimentation and learning, participation and user involvement, leadership and ownership, and evaluation and refinement. These will form the starting point for the development of the ULL framework in the UNaLab project. In another attempt to develop an operationalized definition of ULLs, Steen and Van Bueren (2017) assessed 90 sustainable urban innovation projects in the city of Amsterdam. They identified characteristics of an ULL in four main dimensions i.e., aim, activities, participants, and context. There has also been an attempt by Franz et al. to consider ULLs as a tool to create a contextualized methodology within urban research (Franz, Tausz, & Thiel, 2015). In their presented tool, the key elements of an ULL were summarized as co-creation, exploration, experimentation, and evaluation.

2.1 Purpose and target group

The aim of this deliverable is to present a theoretical ULL framework that can be used by UNaLab front-runner cities as well as follower cities. This framework is based on theories and practices for Living Lab and Action Design Research and approaches for citizen's engagement to support the development of the NBS. This will include planning of the ULL training program in T2.4 and implementation of ULLs in WP5. The framework ensures enhanced stakeholder and citizen ownership of solutions through effective, systematic involvement in co-design, co-development and co-implementation. The framework will build on existing ULL principles and best practices and will define a common implementation model for ULL environments including Key Components, Key Principles and Key Stakeholders.

The framework will also include research approaches for citizen engagement, co-creation, design, test and evaluation in real world contexts with a focus on citizens participating as human actors in the smart city development rather than as factors mainly contributing with data. Training material focused on how to set up and run a Living Lab will be developed (for use in T2.4). The final output from this task is a Handbook for Establishing and Operating Urban Living Labs, which will be disseminated and exploited both within the project and beyond. The handbook will be developed in an iterative matter building on the experiences in UNaLab.

2.2 Contributions of partners

In the process of developing this deliverable, mainly LTU and ENoLL have been involved. As task leader, LTU is responsible for the deliverable and has provided content related to Action Design Research and the ULL framework, including the key principles, key components, ULL definition, and key stakeholders. In addition, LTU has contributed with the development of the tools for how to set up and run a sustainable ULL. ENoLL has contributed with theory on Design Thinking, methods and tools supporting ULL activities and the plan for the training program.

2.3 Relations to other activities

This deliverable is mainly related to T2.2, T2.1, T2.3, and T2.4. The deliverable will also contribute to the demonstrations in WP5. The ULL tools will also play an important role in the project's Replication Framework, which is to be developed in WP6.

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3. RESEARCH APPROACHES FOR CITIZEN ENGAGEMENT

3.1 Responsible Research and Innovation

There is a growing trend throughout Europe to open up research and innovation processes by involving citizens and other stakeholders. This can for instance be seen in the increased participation in design processes supporting Living Labs (Ståhlbröst & Holst, 2017), the urban bottom-up movement (Niederer & Priester, 2016), citizen science (Kullenberg & Kasperowski, 2016), crowdsourcing (Orlikowski & Scott, 2015) and the emergence of responsible research and innovation supported by the European Union (Burget, Bardone, & Pedaste, 2017).

Responsibility and ethics has, more or less, always been an important theme in research and innovation (R&I) (Davis & Laas, 2014; Eden et al., 2013; Jirotka et al., 2017; Stilgoe et al., 2013; Zielinski, 2016). Responsibility and ethics is also a vital part of Living Labs, since these build on ideas from participatory design (PD) where the intention is to develop technologies, tools, environments, businesses, and social institutions that are more responsive to human needs (Bødker et al., 2009; Simonsen & Robertson, 2012).

Currently, there is a growing pressure on R&I to be better aligned with societal interests. This implies that science no longer enjoys a special status; the question of responsibility has gradually become an issue for policy makers, and society at large (Stilgoe *et al*., 2013; Zielinski, 2016). As such, Responsible Research and Innovation (RRI) is the most recent initiative aiming to involve society in R&I in order to align its outcomes with the values of society. Thus, earlier initiatives such as information politics and monitoring of citizens in 1989, Raising awareness of Science and Technology in 1990s, Dialogue, participation and governance in early 2000, and finally From Science and Society to Science in Society in 2007 were replaced by RRI. According to (Zielinski, 2016), RRI reflects on an on-going debate on how to embed science and innovation in a broader, socio-economic context. The issue can also be traced back to 1994 in the 4th EU Framework Programme which introduced ELSA, which stands for ethical, legal and social aspects of emerging sciences and technologies (Zielinski, 2016).

The intention with RRI is to make way for a more reflective and inclusive R&I process, ranging from fundamental research to application design (Eden *et al*., 2013), to bring value to society. Researchers and innovators are expected to address aspects such as public engagement, open access, gender equality, science education, ethics, and governance (Cavas, 2015). Moreover, RRI aims to address the entire R&I process, and should not be interpreted as a yet another code of practice (Eden *et al.*, 2013). Instead, RRI aims to allow "a broad range of stakeholders to systematically engage with the goals, purposes, challenges, problems, and solutions encountered in research and innovation processes" (Jirotka *et al.*, 2017, p. 64). An oft-cited definition of RRI is offered by von Schomberg *(*Davis & Laas, 2014, p. 963*)*;

> *"A transparent, interactive process by which societal actors and innovators become mutually responsive to each other with a view to the (ethical) acceptability, sustainability and societal desirability of the innovation process and its marketable products (in order to allow a*

proper embedding of scientific and technological advances in our society)".

This definition is questioned by Davis & Laas (2014), who identify five problems with the definition: 1) there is no mention of knowledge, instead it is the innovation process and marketable products that are emphasized, which leads to 2) an interpretation of innovations as being mere technical inventions; 3) the innovation process does not always end up with "marketable products" and the market is not the only way to embed scientific or technical advances in society; 4) the phrase "(ethical) acceptability, sustainability and societal desirability" is confusing, as both sustainability and ethical acceptability seem to be societally desirable outcomes; and finally, 5) the phrase "our society" is troublesome. Davis & Laas (2014) argue that research and innovation should consider any society in which it actually will be embedded.

Living Labs, on the other hand, build first and foremost, on the position that end users, or people being affected by technology, are experts concerning the challenges, goals and activities they experience in their everyday context, and therefore have important insights that are beneficial to innovation processes (Leminen & Westerlund, 2016; Schuurman et al., 2016). The Living Lab concept is based on the notion that co-creative innovation processes are effective and contribute to the creation of innovations that add value for their intended end users (Krogstie *et al*., 2013). From an ethical perspective, the Living Lab approach stipulates that people have a democratic right to influence changes that might affect them as a result of an innovation (Bergvall-Kåreborn et al., 2014). This approach has proved its merits in many studies and has resulted in new product features, new value propositions, and identification of bugs in systems; but, more importantly, it has enabled profound understanding of use contexts and the real-life benefits of innovations (Hakkarainen & Hyysalo, 2013; Schuurman *et al*., 2016).

3.2 Participatory Action Design Research

Design science includes many different disciplines and cuts across many different contexts. This is also true of the concepts taken separately. Design, according to Simon (1996) is about devising courses of action aimed at changing existing situations into preferred ones. Within a normative paradigm, science is carrying out studies that add knowledge to the community (Kuhn, 2012). By combining both design and science Simon creates a science of design rooted in both relevance and rigor. Design-oriented research has a long tradition in many Nordic and European countries. Design Science research has established itself as a key research paradigm within mainstream information systems research. Hence, design science has been proposed as a strategy for rediscovering the dual mission of Information Systems: make theoretical contributions; and, assist in solving current and anticipated problems of practitioners (Sein et al., 2011). "As a science, design science has to do with the systematic creation of knowledge about, and with, design. It extends to the scientific study of design and the use of design processes in the scientific creation of knowledge. At its core, design science is directed towards understanding and improving the search among potential components in order to construct an artifact that is intended to solve a problem" (Baskerville, 2008, p. 441).

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For many (Baskerville, 2008, Hevner et al., 2004) design science has its roots in engineering and is seen to originate with the work of Simon (1996) and his work on the science of the artificial. It represents the problem-solving paradigm and seeks to create innovations "that define the ideas, practices, technical capabilities, and products through which the analysis, design, implementation, management, and use of information systems can be effectively and efficiently accomplished" (Hevner et al., 2004, p. 76).

In the UNaLab project, we argue for an application of a mixture of design research, action research and participatory design (PADR - Participatory Action Design Research). In general, action research is mainly focused on developing solutions to practical problems that have value for the people with whom the researcher is working, while at the same time the researcher is developing theoretical knowledge of value to the research community (Chiasson et al., 2009). Action research studies are usually carried out with the objective to improve a practice related to working conditions. In this project, we argue for an engagement of citizens and other stakeholders in the development of the ULL and the NBS; hence, the aim is to improve a city's conditions within a public context.

As such, PADR is a research and design method that is used to foster research and innovation in socio-technical contexts. Because of its foundation in practical action and its aim to solve an immediate problem while informing theory, this method produces highly relevant results (Baskerville, 1998; Baskerville & Pries-Heje, 1999; Baskerville & Wood-Harper, 1998; Rönnerman, 2004; Sein et al., 2011). The method emphasises contribution to both theory and practice; hence, it is important that the researcher considers these two parallel and interacting cycles: the research cycle (focused on the scientific goals) and the real-world practice cycle (focusing on the real-world situation) (Chiasson et al., 2009; Figure 1).

Figure 1 illustrates the dual and interactive processes of research and action. The process might start from the basis of some relevant research themes, or from the real-world situation in the ULL. From the real-world situation cycle, the outcome can be in terms of new knowledge discoveries that contribute to the research community.

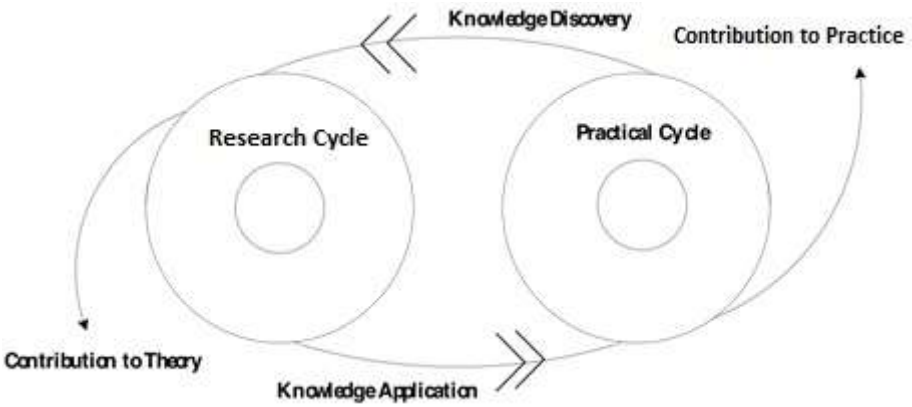

Figure 1 The Dual Processes of Action Research after Chiasson et al. (2009)

In this process, the researcher can be involved in one or more research and problem-solving activities, which can be related intrinsically and are often difficult to distinguish (Chiasson et

al., 2009). Another outcome from the process can be in terms of contributions to the practice as such, with the aim to enhance the situation under study. In the research cycle, theoretical knowledge is applied to the practical situation based on the researcher's focus, which in this project is the creation and management of the ULL. In addition, practical insights from the actions in the practical cycle are used to discover new theoretical knowledge and inform future research (Chiasson et al., 2009). Hence, PADR is an interactive process between research and practice, with one emphasis to collaboratively discover new ways of seeing and designing the participants' actions (Rönnerman, 2004). Using PADR to facilitate the understanding of complex human processes, rather than constructing universal social laws, is a situation in which the researcher is involved actively together with the citizens, and from which the obtained knowledge can be applied immediately (Baskerville, 1998).

The UNaLab project is positioned within the Scandinavian tradition of PADR and will concentrate on the gradual relation between the concepts "access", "interaction" and "participation." Participation is a condition to become a full member of society, which includes a gradual empowering. We will support the concept of transformative participation, wherein the central idea is that the practical experience of participation, obtained through access and interaction, is transformative and empowering in itself. Based on the knowledge gained in UNaLab and ULL processes, city planners and managers are empowered in their strategic decisions and it can also contribute to business growth due to their increased accessibility.

3.3 Co-creation methods and techniques

In this section we will present methods and techniques for co-creation staring with an overarching perspective on design thinking, what it is and how it affects the processes of co-creation. Co-creation and design thinking is the core of Living Lab activities, hence this section will give insights into methods and tools that can support ULL activities in the UNaLab project.

3.3.1 Design Thinking

Design Thinking is an innovative problem-solving process that has been in use for decades, but only started gaining momentum outside the design community in 2008 after an article published in Harvard Business Review (Brown, 2008). The Design Thinking process has since been applied to a wide range of problems, ranging from reinventing solar energy supply in rural areas to operation of Airbnb, an online marketplace and hospitality service. Using Design Thinking methodology, people are able to solve real-world problems in a creative manner. One of the key challenges, however, is to set aside one's own preconceptions and approach a problem with completely fresh perspective (Linke, 2017). For that reason, the real essence of the methodology is to accurately define the problem. In most cases, the defined problem is inaccurate or incomplete. In that scenario, the assumptions are disproved by the users in the later phase of the Design Thinking methodology. Therefore, Design Thinking is an appropriate method for solving complex and non-linear problems, which are not often understood at first glance. To solve these uncommon problems, a mixture of concept modelling and abductive reasoning is used with common design tools (Sanders & Stappers, 2014).

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The use of Design Thinking has spread from strictly design-related fields to all kinds of businesses and companies. Designers and non-designers are thus working together and incorporate "making" as a tool to understand the future and the users. As once strictly defined areas of work have grown beyond initial borders, approaches used by designers to think broadly rather than to confront a problem head-on have spread to other disciplines as well. One key difference between the work of designers and non-designers is that the designers involve creative acts of making. They develop probe packages to see how users respond and interpret them, while guiding their thought process with ambiguous questions. In parallel, users are asked to use toolkits and discuss them, which enables designers to create and evaluate prototypes in iterative cycles. Designers therefore do not just make objects as part of their creative process, but rather as an outcome of creative construction and transformation through interaction with the users. For these reasons, Design Thinking is applied to a wide range of problems. When guided through its five stages of: "*empathize*", "*define*", "*ideate*", "*prototype*" and "*test*" (Figure 2), the methodology can provide unforeseen solutions.

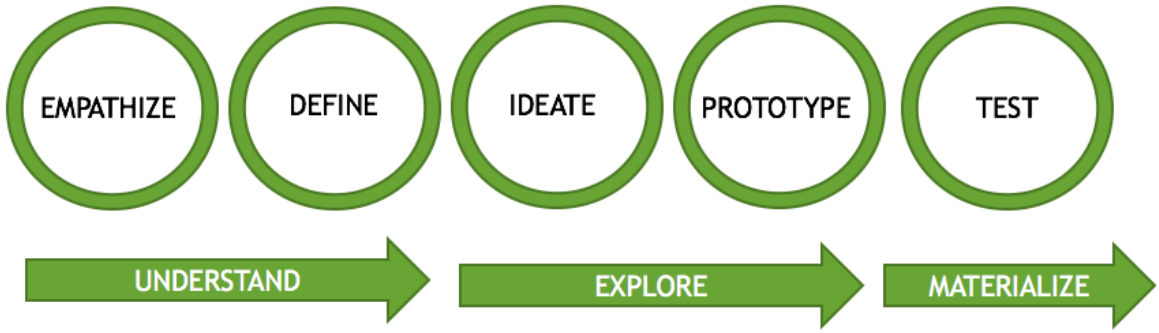

Figure 2 Five stages of the design thinking methodology

Ultimately, Design Thinking is both a divergent and convergent thinking process. That is because a series of studies must be conducted to understand people and their problems and to translate the finding into a problem statement. In the first steps of the Design Thinking process the designer must expand or diverge their thinking while in the user observation phase and afterwards the design thinker should evaluate, filter and refine ideas to reach to a final concept. During the process, the user should continue diverging and converging while going through the steps of the methodology (Van Tyne, 2017). The process of diverging and converging is set as follows (see Figure 3):

- Diverge --> explore aspects of an idea, understand the problem better
- Converge --> after exploring multiple possibilities, the user dismissed dead-end paths and converges around the vision and has a clear idea of the problem
- Diverge --> exploring multiple solutions for the problem and looking for a suitable one
- Converge --> through prototyping and testing, the best possible solution is found

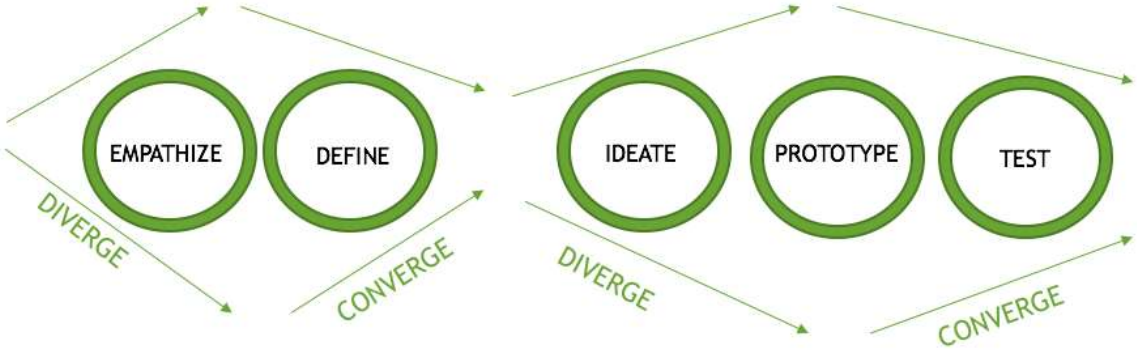

Figure 3 Diverge and Converge process with five steps, following the process described by Van Tyne (2017)

In the following section, based on the publication of the Stanford School of Design (Mode Guide Bootcamp, 2010) different steps of the Design Thinking methodology are described.

Empathize

"*Empathize*" is the first of the five steps of the Design Thinking methodology. This step is designed as a means of understanding people, their needs and recognizing what is important for them. Through the empathize mode, it is revealed why people do certain things and how they do them. To fully understand the users, design thinkers have to gain full understanding of the problems that the users encounter and to do so, must abandon any preconceived notions of the users. For that reason, the first stage is a centerpiece of the human-centered design process that this methodology entails. It helps understand the context of the challenge that a particular group of people faces. In the empathize mode, the Design Thinkers observe what people do and how they interact with their environment. This gives them insights about how people think, how they feel and most importantly it gives an idea of what they need. A person who is following the Design Thinking methodology is able to uncover insights into people's behavior by observing their actions and understand their thoughts. Through these actions, the observer gets an idea of innovative solutions that the users may not envision, since they see a situation from a completely fresh and unconstrained perspective. In addition, through observation Design Thinkers gain an understanding of values and thoughts that the people have, which are not always obvious to people who hold them. It should also be stressed that in the empathize mode, the Design Thinker should not connect a problem under investigation with their own experiences, since it often leads to a false belief that they understand a situation, while the problem at hand is normally broader and more complex.

The *empathize* mode has three important aspects that Design Thinkers need to take into consideration. To empathize, you have to observe, engage, watch and listen. The first step in the empathize mode is to *observe* the subjects. The users and their behavior is observed in the context of their lives. This step is important when comparing the observations with the interviews, since often people behave differently than what they claim in an interview. That is because people are often not aware of how they are acting or they do not think something is relevant enough to be mentioned in an interview. The second step of the empathize mode is to *engage*, which is often called interviewing, although it should not be formal and should be executed in a form of a conversation. Questions for the interview have to be prepared beforehand, however it should be expected that the conversation would deviate from the pre-

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set questions and it would not follow the structure that was established before the interview took place. The interviewer has to follow-up to answers with "why" to discover deeper meaning. The length of the interview varies; the interviews can be short intercepts or longer conversations. The final step in the empathize mode is to *watch* and *listen*. This stage can also be combined with the first two stages. For example, in a workshop the facilitator can ask a participant to complete a task and to go through the steps while describing what they are doing. The participants should also articulate what they are thinking as they are performing a task. The facilitator in turn observes the participants and asks questions.

After all the steps of the empathize mode have been concluded, a facilitator has to reflect on the process, try to understand the broader context and write down their observations. These are shared with fellow designers. The information that the facilitators gather is written on a platform, such as a poster or a wall, which enables the facilitator to make connections between all the impressions and information that was received from the users. When this process is finalized, the facilitator can move on to the *define* mode of the Design Thinking process.

Define mode

The purpose of the *define* mode is to clarify and focus the design space. It is an important step that if not defined correctly and fully, can lead to a solution that is not relevant for the users. In the *define* stage the designer outlines the challenge based on what was observed in the empathize mode and what was learned about the user and its context. In this stage the facilitator makes sense of all the information that was previously gathered. The goal is to put together a meaningful problem statement, also called a "point-of-view", focused on insights and needs of users. When combining information to discover connections and patterns, first conclusions start developing. Development of the "point-of-view" is a critical step in the design thinking process since it explicitly manifests the problem that is addressed. It also allows the facilitator to define the correct challenge, which is found from dispersed discoveries gathered during the *empathize* mode.

In the define mode the facilitator has to think about what stood out during the observation phase and discussions with the people. The facilitator thinks about patterns that emerged from the set and contemplates whether something interesting was observed. The questions which should be asked at this stage are: "why someone has behaved" in a certain manner and "why someone felt" a certain way.

At this stage the Design Thinker has to develop an understanding of the user and know what type of person they are designing for, by looking at a set of needs that should be fulfilled. Combining the knowledge of the user with the insights of the design thinker, the "point-of-view" is developed. It is a problem statement that defines the rest of the design work and provides focus and framework of the problem. Point-of-view should also be inspirational, informing and empowering. If well defined, it naturally leads to the next phase of the Design Thinking methodology.

Ideate

In the *ideate* phase, ideas are generated while concepts and outcomes are widened (diverged). This phase provides materials for building prototypes and putting creative solutions in the hands of the users. It serves as a platform to combine the understanding of the users and their environment with the knowledge the facilitator has to generate solution concepts. A wide range of ideas emerge in the ideation phase, while the best solution is discovered through testing and feedback. The ideation phase is prepared by stepping beyond obvious solutions, as well as connecting common perspectives, discovering surprising areas of exploration and creating variety in innovation options.

Ideation is done by combining rational thinking and imagination through brainstorming. This can be done by building on others' ideas or surrounding oneself with inspiring materials and prototypes, which encourages the growth of new ideas. Techniques that can be used during the ideation phase include bodystorming, mind-mapping and sketching, among others. In all these techniques, judgment must be set aside. Similarly, generation of ideas has to be separated from the evaluation of ideas. First, problems have to be tackled with imagination and creativity. The outcomes are examined afterwards. In the final phase of the ideate stage, the user should go through a process of selection of ideas. Multiple ideas are then brought to the prototyping stage.

Prototype

The prototyping stage occurs when a problem has been defined and a prototype can be developed. A prototype is an interactive tool of various shapes. It ranges from a wall with post-it notes, to an activity, a story board or a gadget. A prototype should help users experience a situation and engage them in a story. The reason why prototyping is one of the key steps of the design thinking methodology is because it:

- Helps ideate and problem-solve
- Starts a conversation and ensures continuous communication
- Fails quickly and cheaply, since it is usually made rapidly and with few resources for testing purposes only; if the prototype is not useful, it can be easily removed
- Tests possibilities and allows users to explore different ideas before deciding on a direction
- Manages the solution-building process, by breaking the problem into small testable pieces

Prototyping phase has four different components. It starts with building a prototype, simply by picking up materials and putting them together. Rather than spending a great deal of time on one prototype, different prototypes should be explored to ensure that a wide range of ideas are developed. Since a prototype should answer a particular question, it should clearly identify what exactly will be tested with a prototype. And lastly, a prototype should be built with a user in mind while expectations of the user are taken into consideration. These steps ensure that good feedback is received in the testing phase. In fact, the prototyping and testing phases should be considered in tandem, since many questions have to be answered before a prototype is made.

Test

In the testing stage of the design thinking process, the facilitator seeks feedback from the users about the prototypes that were created and presented to them. This phase gives the Design Thinker an opportunity to get to know users better, with the advantage of already having framed the problem and created a prototype to test. The testing phase focuses on interaction with the users; however, testing should not be limited to asking users if they like the solution that was presented to them. The way to test a prototype is by asking users questions starting with "why" and focusing on learning more about the users and the problem as well as the potential solution. In an ideal scenario, the prototype should be tested in the users' environment or at least tested in a real life context. If for example, a physical object is developed, users should take it with them and use it in their daily life. If, on the other hand, an experience is tested then users should experience it in an environment that approximates their own. Testing gives the Design Thinker an opportunity to fine-tune solutions and to make them better.

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There are three main reason why a prototype should be tested:

- To improve the prototype and solutions that were developed. Testing gives guidance for next iterations of prototypes
- To learn more about the user and to build empathy towards the user through observation and engagement
- To refine the Point-of-view and understand whether the problem was correctly framed

Execution of the testing phase is simple. The user should receive a prototype without instructions and interpret it on their own. The prototype developer then observes how the user interacts and uses the prototype. Afterwards, the developer should listen to the user when explaining their perception, understanding of the prototype and questions regarding its use and applicability. The prototype should be tested as part of an experience. Multiple prototypes could be compared and tested by users, since that often reveals covert needs of the users.

When the testing phase is concluded and all information about the prototype is gathered from users, iterations begin. Iterations are fundamental for a good design and often designers have to repeat the cycle to refine the problem and to make sure that the prototype received good feedback from the users.

3.3.2 What is co-creation?

Co-creation is a key process in the **Open Innovation** journey. According to the European Commission, the basic premise of Open Innovation, for which academics have coined the term **Open Innovation 2.0(OI2)**, is to open up the innovation process to all active players so that knowledge can circulate more freely and be transformed into sustainable products and services for all (2016). This means that innovation can no longer be the result of predefined and isolated activities but rather the outcome of a complex co-creation process that involves knowledge flows and absorptive capacities from all actors involved across the entire economic and social environment (European Commission, 2016). Industry, Academia, Public Authorities and Citizens are part of the so-called **Quadruple Helix model**, where users are placed at the heart of the innovation ecosystem. This means that **citizens/users must be considered as actors**, **not factors**, of the innovation process. Actors have their own knowledge base, individual needs, and reasons to contribute to the creation of new products and services. In this vein, co-creation relates to the various levels of involvement of end-users in the different stages of service/product development. How is the co-creation process applicable to different public-private contexts?

3.3.3 Public Sector: co-designing and co-producing public services

In the **public sector**, the end-users are the citizens. Many policy makers consider co-creation with citizens as an essential condition to create innovative public services that effectively meet the needs of citizens, given a number of societal challenges. In this respect, co-creation is often recognized as a creative practice and a cornerstone of **social innovation**, especially within the public sector. Voorberg *et al.* (2014) offer a systematic literature review on co-creation in the public sector in which citizens are considered as a valuable partner in public service delivery. This partnership can take place in **different stages** of the process. For this report, we will simplify the categorization in two main phases: **co-design** and **co-production.**

> **Co-design**. The terms *co-design* and *co-creation* are often confused and sometimes treated synonymously with one another. Co-design is also frequently considered as a

specific instance of the broader concept of co-creation. Its roots can be found in the participatory design techniques (i.e. 'user as a partner') developed in Scandinavia in the 1970s (Sanders & Stappers, 2008), where joint decision-making and work practices began to receive attention. What, then, is it that makes co-design different to other kinds of participation or citizen engagement? Co-design places the involvement of citizens at the very heart of the design of a public service. This enables a wide range of people to make a creative contribution in the formulation and solution of a problem, going beyond consultation by building and deepening equal collaboration between citizens affected by, or attempting to resolve, a particular challenge (Bradwell, P. & Marr, S., 2008). A key principle of co-design is that users, as 'experts' of their own experience, become **co-designers**. As a result, co-design has the potential to build lasting connections and relationships between individuals and institutions, making public services more efficient, to understand and better meet the needs of their users, and to build a sense of reciprocity between those users and service providers (Bradwell, P. & Marr, S., 2008).

Co-production. Unlike co-design processes, co-production puts the emphasis on the contribution made by the service beneficiary (citizens) in the service delivery process (Bovaird, 2011). Co-production approaches have emerged in recent years across Europe in both the public and voluntary sectors. This has often been for mixed motives – not simply in order to improve service quality by bringing the expertise of the user in, but also in order to cut costs, by making the users do more for themselves inside the service delivery process (Löffler et al., 2008; Boyle & Harris, 2009). Co-production shifts the balance of power, responsibility and resources from professionals to individuals by involving people in the delivery of their own services. It recognizes that people are not merely repositories of need or recipients of services, but are the very resource that can turn public services around. The central idea is that people who use services are hidden resources, not drains on the system, and that no service that ignores this resource can be efficient. The people who are currently defined as users, clients or patients provide the vital ingredients that allow public service professionals to be effective. Consequently, we define co-production as "the public sector and citizens making better use of each other's assets and resources to achieve better outcomes and improved efficiency" (Bovaird & Löffler, 2011). We can distinguish a set of service activities which can be included in the co-production umbrella (Löffler, E., et al., 2008).

- **Co-decision** in resource allocation, e.g. participatory budgeting at local level;
- **Co-delivery** of public services, e.g. volunteers of fire services, jurors in courts, parent governors in schools, etc.
- **Co-evaluation** of public services, e.g. citizen inspectors in public hospitals and social housing.

When considering the determinants for successful co-creation practices, Voorbeg *et al.* (2014) identified a series of **influential factors** that affect the level and quality of the co-creation process. These can be separated into being at either the organizational or the citizen side of co-creation. On the **organizational** side, the following factors seem to have an important influence on the development of co-creation experiences:

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- **Compatibility of public organizations with respect to co-creation.** This refers to the presence or the absence of inviting organizational structures and procedures within the public organization or the presence or absence of a suitable infrastructure to communicate with citizens.

- **The attitude of public officers and politicians towards co-creation.** Many politicians, managers and professionals consider co-creation to be unreliable, given the unpredictable behaviour of citizens. Therefore, political and professional reluctance to lose status and control may be considered as an explanation for unwillingness to support co-creation/co-production.

- **A risk-averse, conservative administrative culture.** The lack of a tradition to consider citizens as associates, rather than service-receivers, implies that there is no 'institutional space' to invite citizens as equals. This seems to explain why citizens are sometimes considered to be an unreliable resource providing partner.

- **Having clear incentives for co-creation.** For instance, for public officers, it is often unclear to what extent public services can be improved by incorporating citizens or how co-creation creates budgetary benefits or even increases customer interest. Without clarity about these incentives, administrators do not see its usefulness.

In the same vein, there are a series of factors on the **citizen side** that either stimulate or harness the adoption of co-creation methods, including:

- **Citizens' personal characteristics.** These can determine to a large extent whether citizens are willing to participate. Intrinsic values, such as loyalty, civic duty and the wish to improve the public sphere positively, make citizens more eager to participate. Similarly, citizens' personal connection to the topic at issue is a crucial factor in determining their level of engagement.
- **A sense of ownership and the perceived ability of citizens to participate.** In the same way people need to be willing to participate, they need to feel it is their responsibility, but also need to be aware of how and where they can influence public services.
- **Social capital.** In order to involve citizens in a sustained way, social capital needs to be energised in order to fulfil the promises of collective action. A well-knit social structure is an important ingredient to develop a robust sense of trust and commitment between citizenry and relevant stakeholders.

Ultimately, incorporating co-creation dynamics in public service design and delivery generates a series of beneficial **outcomes** worth mentioning (Voorbeg *et al., 2*014):

- It leads to **better, more responsive services.** Services are more tailored to the needs of individuals, and are quicker to respond to changes in those needs;

- It brings forward a **more equitable governance model** by tackling disengagement from politics and democracy. Along with democratic renewal, participation enhances trust in, and positive engagements with, services;
- It builds **social capital**. Participative governance enhances community cohesion, improves the quality of people's lives, and strengthens individual relationships;

For more detail, see Figure 4.

		Design of Services		
		Professionals as service designers	Professionals and users as service co-designers	Users as service designers
Production of Services	Professionals as service producers	Traditional professional service delivery	Professional service delivery but users involved in design	Professionals as service deliverers
	Professionals and citizens as co-producers	User co-production of professionally designed services	**Full co-production**	User delivery of services with little formal/ professional input
	Users as producers	User production of professionally designed services	User delivery of co-designed services	Self-organised community production

Figure 4 User and Professional Roles in the Design and Delivery of Public Services, after Boyle, & Harris, 2009)

3.3.4 Private Sector

In the **private sector**, co-creation follows a slightly different line. Here the end-users are the customers or consumers of a product or service. Two contexts in particular where consumer co-creation is increasingly vital are the areas of **new product development (NPD)** and **new**

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service development (NSD). Consumers are able and willing to provide ideas for new goods and services that may fulfil needs that have not yet been met by the market or might improve on existing offerings (Hoyer et al., 2010). Furthermore, they are now able to easily communicate these ideas to the company through websites, e-mail, and social networks. Having said that, co-creation is not the transfer or outsourcing of activities to customers, nor a marginal customization of products and services (Prahalad & Ramaswamy, V., 2004). Co-creation implies personalized interactions that are sensitive to a specific consumer. In this sense, co-creation can be valuable at all stages of the **NPD/NSD process, which include: ideation, product/service development, commercialization, and post-launch.** A complete insight in the needs of a company's customers and users is essential to create successful products and services that create added value.

To analyze the degree of co-creation effort, research by Hoyer *et al.* (2010) on consumer co-creation and NPD identifies a series of factors that influence the adoption of co-creation practices both from the company and consumer sides. See Figure 5 for more details.

- **Company-Level.**

  Firstly, co-creation requires a fair amount of **transparency** on the part of the firm, since it involves the revelation to consumers of information on NPD/NSD trajectories and ideas. As such, firms that rely greatly on secrets to protect proprietary knowledge in their NPD/NSD process are less likely to engage in intense and wide-ranging co-creation activities. Companies might also have to answer questions regarding **intellectual property.** Firms that emphasize retaining ownership of intellectual property rights for themselves are therefore less likely to engage in a high degree of co-creation. Ultimately, co-creation activities might lead to large volumes of consumer input, sometimes meaning **information overload**. However, when consumers are also involved in the post-launch evaluation stages, they can help to reduce the volume.

  Companies can **stimulate consumer co-creation** by **increasing the benefits** that consumers receive from participating in the co-creation process. Most consumers are likely motivated by a combination of these factors and therefore, a multi-pronged approach that targets several motivators (financial, social, technological, and psychological) may be most effective. Companies can also stimulate co-creation **by reducing the costs** to consumers of participating in consumer co-creation (in terms of time, effort, and foregone opportunities). One approach to reduce costs is to provide user toolkits, which ease the process of creating new ideas, products, and marketing materials for potential participants. Another is to modularize the NPD/NSD process, so that consumers are assigned to or select into modules and can focus on the components of the NPD/NSD process for which they have the greatest expertise and passion, and are likely therefore to be more efficient at completing the co-creation task.

- **Consumer-Level.** Co-creation involves, on the part of consumers, monetary and non-monetary costs of time, resources, and physical and psychological effort to learn and participate in the co-creation process. Relative to these costs, consumers compare benefits of engaging in co-creation activities (Etgar, 2008; O'Hern and Rindfleisch, 2009). In this sense, some consumers are motivated by **financial rewards**, either directly in the form of money or profit sharing from the firm they co-create with, or

indirectly through the intellectual property that they might receive. Some may receive **social benefits** from titles or other forms of recognition that a firm might bestow on particularly valuable contributors. Social benefits of co-creation comprise increased status, social esteem, ‘‘good citizenship,’’ and strengthening of ties with relevant parties. Other consumers might be motivated by a desire to gain **technology (or product/service) knowledge** by participating in forums and development groups run by the company. Finally, consumers may participate in the co-creation process for **psychological** reasons that remain poorly understood. Creative pursuits of co-creation are likely to enhance intrinsic motivation and sense of self-expression and pride. Moreover, some consumers may participate purely from a sense of altruism. They may do so because they genuinely believe in the objectives of the NPD/NPS effort (such as in medical product development efforts).

Co-creation at different stages of NPD/NSD

Research has shown that the early stages of the innovation process are vital for the success of new products and services (Hoyer et al., 2010). A high degree of consumer co-creation at the **ideation** and **product/service concept development** stages can contribute significantly to a company’s performance. Further, companies can now leverage new technologies to co-create value with customers in a more intensive and efficient manner. In the ideation stage, the use of social media can vastly increase the magnitude of inputs companies can obtain from consumers at a significantly lower expense. Ultimately, involving customers in the early stages of NPD can both save time and costs and reduce the risks of a potential new product failure (Hoyer et al., 2010). After consumers become aware and interested in a new product/service, their involvement in value co-creation at the **commercialisation and post-launch stages** is crucial. This is when a trial needs to be instigated because the experience of other consumers can be more meaningful for potential buyers than information provided by the company. Thus, consumer involvement can act as an early warning system. At the post-launch stage, consumer participation may empower the consumers to respond to a product or service failure in a manner that reduces negative outcomes of the failure.

Ultimately, consumer co-creation practices, if successfully implemented and managed, can create two main **sources of competitive advantage** on the company side: productivity gains through increased **efficiency** (e.g., by reducing operational costs); and improved **effectiveness (**e.g., through an increment of product value, innovativeness and learning capabilities, and a better match with consumer needs). Overall, co-creation increases the success rate of new innovations and **lowers the risk of expensive failure.** Constant co-creation and rapid prototyping with end-users produces cost-effective MVPs (Minimum Viable Products) that can identify and fix potential bugs in the product/service, user adoption misalignments or user interface interaction issues (relating for example to UI/UX = user interface/user experience). On the consumer side, involvement in a co-creation process makes businesses more customer-oriented and thus, more responsive to the customer’s needs. In addition, the consumer is better acquainted with the challenges, costs, and constraints of creating a new product, resulting in adjustments in preferences and better appreciation of the product.

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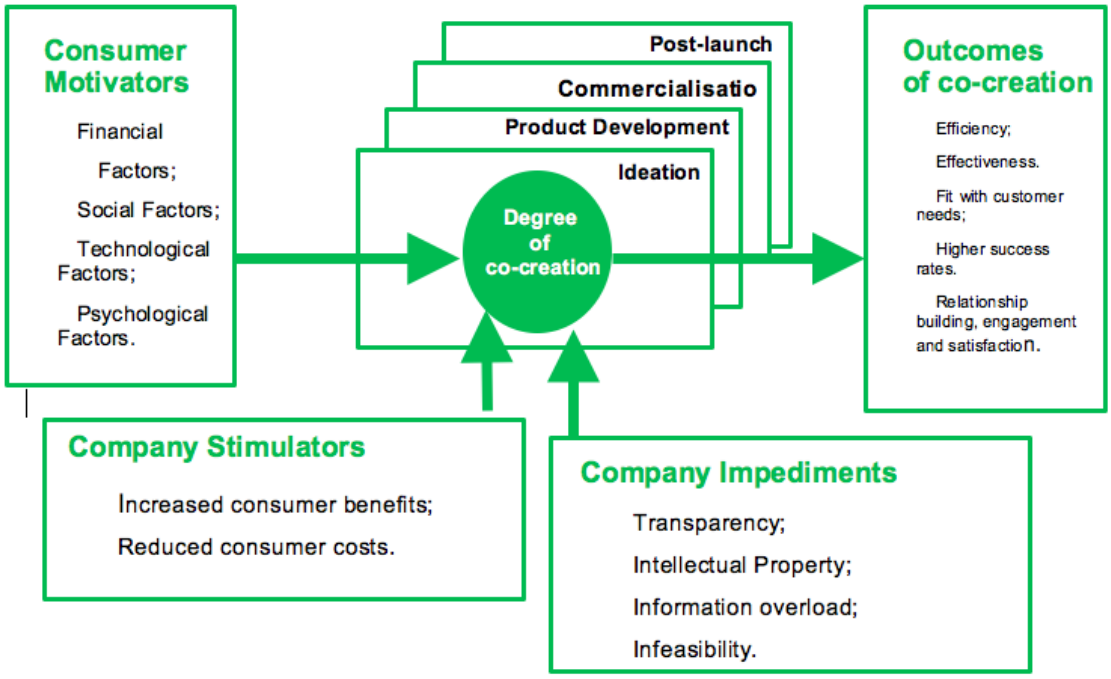

Figure 5 Conceptual Framework of Consumer Co-creation, after Wayne, D. & Hoyer et al. (2010)

3.3.5 Methods and Tools

The spectrum of co-creation is quite a nuanced construction, which instigates the question of **how co-creation can best be put into practice**. According to Bradwell and Marr (2008), one of the necessary conditions for a successful co-creation process is having a methodology that supports and actively encourages its core properties. This requires a well-defined process architecture to ensure process aims are met, both regarding outcome and to the nature of the process itself. For the purpose of the UNaLab project, **Design Thinking** and the **European Awareness Scenario Workshop (EASW) method** have been chosen as the most appropriate methods to co-create innovative NBS for front-runner cities. Tim Brown (president and CEO of IDEO, a global human-centred design company) defines Design Thinking as a discipline that uses the designer's sensibility and methods to match people's needs with what is technologically feasible and what a viable business strategy can convert into customer value and market opportunity. The Design Thinking process is best thought of as a system of overlapping spaces rather than a sequence of orderly steps. There are three spaces to keep in mind: **inspiration, ideation, and implementation.** Similarly, the **EASW** is a method born in Denmark that aims at finding an agreement between the different groups of actors at the local level with the purpose of reaching a consensual definition of a sustainable city. In conjunction with this, a wide range of **tools and techniques** are available to support the co-creation process. Potential solutions can be tested through prototyping and scenario generation techniques. The **Service Design Tools site** based on the work of Roberta Tassi (2009) provides a good selection of co-design tools (see Figure 6).

	Phase 1	Phase 2	Phase 3	Phase 4
	Co-Designing	**Envisioning**	**Testing & Prototyping**	**Implementing**
Tools	· Lego Serious Play · Role Play · Issue Cards · Rough Prototyping · Character Profiles · Mind Map · Story Telling · Character Profiles · Affinity Diagram	· Service Image · Touchpoints Matrix · Evidencing · Personas · Offering Map · Actors Map · Tomorrow's Headlines · Customer Journey Map · Moodboard	· Service Prototype · Experience Prototype · Mock up	· Task Analysis Grid · Role Scrip · Specification · Blueprint · Service Prototype · Use Cases

Figure 6 Service Design Toolkit by Roberta Tassi (2009)

Similarly, the **U4IoT toolkit** (http://www.u4iot.eu/end-user-engagement-toolkit) for the European Large-Scale Pilots Programme was specially developed to guide pilot sites through innovation processes with a particular focus on user engagement. It is comprised of a combination of tools and techniques in a format that follows the different phases along the innovation process: **exploration**, **experimentation** and **evaluation**. These have been further divided in 3-5 iterations (Figure 7) with the intention of encouraging an iterative approach in which it is recommended to jump back and forth and alter the order of the different stages and respective tools and techniques (U4IoT, n.d).

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	Phase 1		Phase 2		Phase 3	
	Exploration	**Tools**	**Experimentation**	**Tools**	**Evaluation**	**Tools**
Iteration 1	**Understand**	Photo Journal Collage Laddering Bootcamp Bootleg	**Prototype**	IDEO Prototyping Solution Prototype vs. Empathy Prototype MVP Community Canvas	**Launch**	Scum & Sprint Business Model Canvas Value Proposition Canvas
Iteration 2	**Discover**	Game Jams Guided Tour Observation & Shadowing Empathy Prototype	**Test**	Usability Test I like I wish Prototype Testing Plan	**Implement**	Co-implementation Social Media Strategy
Iteration 3	**Define**	User Persona Empathy Map Validated Personas Customer Journey	**Develop**	Design with Intent Hackathon SILK method cards CTA Toolbox	**Identify**	Crowdsourcing Growth Hacking Canvas
Iteration 4	**Think**	Idea Dashboard Brainstorming Rules How might we				
Iteration 5	**Conceptualise**	Tips & Tricks Six Thinking Hats				

Figure 7 U4IoT End-User Toolkit

The **UNaLab co-creation toolkit (D2.3)** will aim at supporting the development of Urban Living Labs in front-runner and follower cities for the co-creation of NBS in real-life environments. This will be a fine-tuned and tailored toolkit for the cities to suit their respective water and climate-related challenges. **How different will it be from other toolkits?** The UNaLab toolkit will offer a set of operational techniques for establishing and running an Urban Living Lab that will enable cities to involve citizens in the co-creation of NBS. It will also provide cities with a collection of instruments for stakeholder engagement of NBS based on the Quadruple Helix model, thus offering wider possibilities than a pure end-user toolkit. The UNaLab ULL toolkit, together with the ULL trainings, will initiate a process through which stakeholders will be able to influence and share control over NBS development initiatives and the decisions and resources that affect their cities.

3.3.6 Co-creation for NBS

Urban environmental issues have become the subject of public debate in which knowledge from multiple actors is needed for effective interventions and inclusive governance approaches to be adopted (Frantzeskaki & Kabisch 2016). Nature-based solutions require planning and governance architectures that support accessibility to green spaces, while maintaining their quality for the provision of ecosystem services. Nature-based solutions also offer the opportunity to enhance well-being and strengthen community cohesion in cities (European Commission, 2015). The involvement of society and individuals in the co-creation of NBS aims to reconnect people with nature, raising awareness of societal benefits, and creating a public demand for healthy natural environments (European Commission, 2015). In this context, Living Labs offer powerful tools to instigate new forms of environment co-creation for cities.

4. DEFINING URBAN LIVING LABS

In this section, we will present the current research and approaches available in literature and we will give a definition of ULL, including ULL key components, key principles and key stakeholders.

4.1 Definition of ULL

Research regarding Living Labs shows that there is a growing trend to involve citizens (and other stakeholders) in different city development projects to make urban areas more adaptable to different citizens' needs in order to both prevent e.g. social problems and gain advantages by being more adaptive to citizens' needs. Today, urban areas are seen by different stakeholders (city planners, universities, and technology companies) as natural places to develop ideas in Living Labs settings (Juujärvi & Pesso, 2013), i.e. Urban Living Labs (ULL). In comparison with Living Labs (LL), which have a focus on facilitating interaction between end-users and private actors, ULLs are more oriented on 'urban' or 'civic' innovation (Baccarne et al., 2014b). Baccarne et al. (2014b) highlight that ULLs are often supervised by (or have a close relation with) the local government and have a strong focus on social value creation and civic engagement and on non-commercial activities (Baccarne et al., 2014a).

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The distinction between LL and ULL is thus not clear in the literature. Schliwa (2013) states that Sustainable Living Labs (SLL) targeting generation of knowledge within a small-scale real-life laboratory is similar to ULLs with a focus on the implementation of socio-technical innovations on a larger urban territory targeting knowledge generation as well as application. In the case of ULLs, the arena they focus on (the geographically, temporally and institutionally bounded space) is thus broader (Schliwa, 2013), i.e. the ULL expands its activities on a broader urban territory which also affects the way that key stakeholders are engaged (Schliwa, 2013). Also, what makes ULL distinct is their focus on knowledge and learning as a means through which such interventions can be successfully achieved (Bulkeley et al., 2017).

ULL Definitions

Beginning with the definition of LL, literature highlights a variety of definitions of the Living Lab phenomenon. However, researchers often adopt existing definitions related to the concept of 'Living Lab', such as the one used by the European Network of Living Labs (ENoLL, 2016): *"Living Labs are defined as user-centered, open innovation ecosystems based on systematic user co-creation approach, integrating research and innovation processes in real life communities and settings"* (Steen & Van Bueren, 2017, p.22). Urban Living Lab can also be seen as a forum for innovation, applied to the development of new products, systems, services, and processes in an urban area (Holopainen, 2016).

Steen and van Bueren (2017) highlight that the term "urban Living Lab" refers often to a variety of local experimental projects of a participatory nature, but often used interchangeably with the terms: "testing ground", "hatchery", "incubator", "making space", "testbed", "hub", "city laboratory", "urban lab", or "field lab" (Steen & van Bueren, 2017).

ULL literature shows that there is a variation and fuzziness in the ULL definition and no uniform definition (Voytenko et al., 2016). Steen and van Bueren's literature review (2017) shows that ULLs have been explained to encompass a methodology, an environment, a system, and a governance approach. One reason for the fuzziness can be that urban areas are often of different character, and characterized by complex problems, such as social and economic deprivation, segregation, or bureaucratic administration (Juujärvi & Lund, 2016). Some of the definitions are highlighted below.

- An urban Living Lab has been defined as a regional forum for innovation and dialogue focusing on solving challenges in the urban area (Friedlich et al., 2013).
- Juujärvi and Pesso (2013) discuss that since the urban Living Lab is an emerging concept referring to a Living Lab in an urban environment (e.g. neighbourhood), urban Living Labs fit Westerlund and Leminen's (2011) definition of the Living Lab as a "virtual reality or a physical region" in which different stakeholders form public-private-people partnerships acting in a real-life contexts. Juujärvi and Pesso (2013) mean that an urban Living Lab can be seen as a special type of regional innovation network that puts emphasis on residents and their communities as users (i.e., ordinary people who want to solve their real-life problems).

- Nevens et al. (2013, p.115) consider "an Urban Transition Lab as the locus within a city where (global) persistent problems are translated to the specific characteristics of the

city and where multiple transitions interact across domains, shift scales of operation and impact multiple domains simultaneously (e.g. energy, mobility, built environment, food, ecosystems). It is a hybrid, flexible and transdisciplinary platform that provides space and time for learning, reflection and development of alternative solutions that are not self-evident in a regime context."

The emerging interest in urban Living Labs calls for more precise definitions of the concept. It is argued by Lund and Juujärvi (2015) that an urban Living Lab can be defined as "a forum for innovation, applied to the development of new products, systems, services, and processes in an urban area; employing working methods to integrate people into the entire development process as users and co-creators to explore, examine, experiment, test and evaluate new ideas, scenarios, processes, systems, concepts and creative solutions in complex and everyday contexts" (JPI Urban Europe, 2015b, p.59).

- In relation to smart cities, Juujärvi & Pesso (2013, p.22) define Urban Living Labs as "a physical region in which different stakeholders form public-private-people partnerships of public agencies, firms, universities, and users collaborate to create, prototype, validate, and test new technologies, services, products, and systems in real-life contexts".
- Conceptually, "ULL can be seen as part of a phenomenon by which forms of innovation and experimentation are being marshalled as a means through which to govern particular (urban) conditions" (GUST, 2015).

To give some clarity to the ULL definitions, Lund and Juujärvi (2015) distinguish at least three types of urban Living Labs. They contend that ULLs capture many essential features identified in the Living Lab literature: 1) they represent an ecosystem or networks involving multiple stakeholders that are motivated by different objectives but would benefit from collaboration. 2) ULLs provide tools for enhancing and implementing public and user involvement. 3) ULLs can be seen as an innovation management tool for building networks and user involvement in urban development.

Related to the ecosystem concept, Baccarne et al. (2014a) focus on Urban Living Lab as a collaborative ecosystem allowing for the co-creation of sustainable, future proof innovations that improve life in the city and boost the economy, thereby contributing to Smart City targets. Such Urban Living Labs should act as 'reuse enablers' through central governance of 'fertilizing' resources.

What is clear across the multiple definitions is that ULLs are bringing existing constellations of urban actors together in new ways to create more collaborative and experimental ways of 'doing' urban development. A key question warranting further research involves the extent to which this model of urban development extends beyond individual projects to become embedded in existing modes of governance (Voytenko et al., 2016). Urban Living Lab can also be a vehicle to foster communication in public space (Gaiddon et al., 2013). Urban Living Labs could work as an intermediary bringing self-organizing groups and city developers together to

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co-create urban space. Thus this potential can be lost if urban Living Labs are poorly managed (Juujärvi & Lund, 2016).

4.1.1 Key components 3

Several Living Lab studies have presented different components for Living Labs. One of these studies is Bergvall-Kåreborn and Ståhlbröst's study (2009) in which five key components for Living Labs were identified, namely users, application environments context, the technology and infrastructure, organisation and methods, and finally partners. However, as mentioned earlier, there is still no clear distinction between LLs and ULLs within previous literature and there are few studies that have explored the key components of an ULL.

In an attempt to define characteristics of ULLs, Steen and van Bueren (2017) developed a definition for urban Living Labs and used it in order to assess 90 sustainable urban innovation projects in the city of Amsterdam. They summarized the characteristics of Living Labs into four key components: aims, activities, participants, and context. The main goals of a ULL were identified as innovation and learning. The main activities consist of co-creation and decision power as well as feedback and iteration. When it comes to participants, public and private actors, citizens (users) and knowledge institutes are the key participants. Finally, the context in the ULL reflects real-life everyday use. In the following, we reflect on the key components of Living Labs.

In another study, in order to develop a research agenda on how the ULL concept is being operationalized in contemporary urban governance for sustainability and low carbon cities, Voytenko et al. (2106) conducted a literature review followed by five case studies of ULL projects. In their study, they identified five key ULL characteristics namely: geographical embeddedness, experimentation and learning, participation and user involvement, leadership and ownership, and evaluation and refinement.

There has also been an attempt by Franz et al. (2015) to consider ULLs as a tool to create a contextualized methodology within urban research. In their presented tool, the key elements of an ULL were summarized as co-creation, exploration, experimentation, and evaluation. Considering the above-mentioned studies, in this deliverable we ended up with six key components which are in line with the goals and objectives of an ULL. These key components are innovation with which to experiment, citizens to engage, methods or approach, management structure for governance, infrastructure to support real-life experimentation, and finally a mixture of partners with stable and dynamic relations. In the following, the key components of an ULL are discussed in greater detail.

Approach. The Living Lab approach represents the methodology that the research or projects follow. It might consist of tools, various data collection and analysis method and different tools that support Living Lab activities. A mixture of methods for engagement of different stakeholders and data collection can be considered as a Living Lab approach. An ULL approach outlines the experiments that are conducted for socio-technical innovation in an urban context. Accordingly, the NBS are developed in a collaborative manner in which citizens, researchers,

decision-makers and practitioners are involved in data collection and experimentation in an iterative and long-term process.

Citizens. Citizens or individual users are one of the more important sources of knowledge and innovation, especially with regard to open innovation. In Living Lab studies, it is highly recommended that individual users must be included in the open innovation process not only as sources of technology use, co-creators and co-testers, but also as a source of innovation by active engagement throughout the duration of Living Lab activities. Living Labs put the users and citizens at the center of the innovation process. In ULLs, citizens are one of the main participants that have decision-making power as the NBSs can be initiated, co-created, tested and evaluated by them. In so doing, it is of vital importance to pay sufficient attention to the citizens' motivations and their needs.

Infrastructure. Living Labs should have access to multi-contextual technologies and infrastructures that support different tasks and activities in open innovation processes in which various stakeholders are able to collaborate, interact, co-create, design, test and evaluate innovations. In an ULL, the whole city or a part of it can be considered as a laboratory in which the innovation process can benefit from the infrastructures of the cities as the innovation platform in order to support real-life experimentation. ICT-infrastructures such as IoT deployments, sensor networks, distributed tools, etc. are considered as enablers of collaboration between different stakeholders and citizens. By involving technological infrastructures in the process of real life everyday use context, social practices are observed and NBSs are developed, implemented, tested and evaluated. The goal of employing ICT-infrastructures is to facilitate citizens' engagement process in their real life setting within an urban context.

Innovation. Living Labs can be employed as an environment that facilitates the innovation process. Innovation is the first and foremost important component in Living Lab activities. In an ULL, sustainable innovations are generated and adopted in the urban systems in light of the urban sustainability transition (Steen and van Bueren, 2017). Within the UNaLab project, NBSs are innovations that aim to develop smarter, more inclusive, more resilient and increasingly sustainable societies that are co-created by different stakeholders and participants in an ULL environment. Active citizens' engagement throughout the innovation process is the key factor for the successful development of NBSs that are co-created, designed, tested and evaluated in the real-life urban context in an ULL.

Governance. Within a Living Lab approach, the governance describes the way that a Living Lab research or activity in the strategic or operational level is managed and organized. Considering cities and more particularly urban context as a platform for innovation, an ULL can be conceived as a government approach and as means of governance of urban innovation (Bulkeley et al., 2016). Accordingly, local governments and other stakeholders are engaged in order to solve problems through urban development. With regard to governance in the UNaLab project, the NBSs for different challenges such as water resilience, urban sustainability and climate change at both strategic and operational levels are described and an experimental governance to develop, co-create and test these NBSs will be applied.

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Partners. Partners are in fact various stakeholders who participate in the Living Lab activities. They could be private actors, public actors, citizens, and/or knowledge institutes in which all of these partners have the power of decision-making. In order to create a sustainable solution and innovation, a significant partnership between various actors such as citizens, researchers, local governments and companies needs to be established. In this way, UNaLab aims to establish a strategic partnership between public and private sectors i.e., cities, innovative SMEs, industries, etc. All partners including citizens must be sufficiently motivated in order to be engaged in the innovation process of NBSs.

4.1.2 Key Principles

In order to support Living Lab research in the innovation context and assess the impact of the Living Lab approach in innovation processes, a set of key principles were proposed by Ståhlbröst (2012). In her study, value, openness, realism, influence, and sustainability were identified as the main principles concerning Living Lab projects and activities. Although, when it comes to the ULL context, there are other principles that need to be considered such as responsibility, sustainability, experimentation as well as the explorative nature of innovation activities and solutions in the ULL. In the following, the key ULL principles are discussed in more detail.

Societal and value creating. One of the key points that distinguishes ULLs from other types of Living Lab is that societal changes are influenced by ULLs through a shared vision in a long-term period. In a study of three Living Lab cases in order to present a new perspective on Living Labs by introducing the design-driven Living Lab, Brankaert *et al.* (2017) argue that the scope of innovation can be widened through the Living Lab approach, and it enables us to gather new perspectives on value proposition in order to address societal challenges and provide innovative solutions.

Open and inclusive. The openness principle highlights that all stakeholders should be engaged in the innovation process as much as possible. The open innovation process might be initiated from a very early stage of innovation process such as ideation and will be continued until the last phases of innovation and development process, i.e., test and evaluation of the prototype. Accordingly, the flow of knowledge and experience must be multi-directional between all stakeholders, including research centers, universities, Living Lab organizations, companies, developers, citizens and end users. In the UNaLab project, it is of crucial importance to maintain openness while involving citizens through the development and innovation processes of NBSs.

Explorative. Another key principle in an ULL refers to the nature of the innovation process in an ULL, which is driven by curiosity and the unknown. Within an ULL, co-creation of innovation is based on an explorative environment that makes it difficult to predict whether a specific phase of the final solution will be achieved (Franz et al, 2015).

Responsible and sustainable. Creating a sustainable environment is one of the key principles of Living Lab activities. Sustainability can reflect both the sustainability of the Living Lab as well as its responsibility to the wider community in which the Living Lab operates (Ståhlbröst, 2012). Sustainability requires a collaborative approach between the key stakeholders that considers the city, owners of the buildings and users and citizens at the center of the sustainable

innovation process (Romero et al., 2009). When it comes to the development process of NBSs within UNaLab project, evaluation and anticipation of the impact of the innovation on individual, organisational and societal levels both now and in the future must be considered as a key principle. On the other hand, responsible innovation puts emphasis on the ethical aspect while an innovation is being designed and developed.

Real life context. Real-life everyday use context is one of the most important principles in Living Labs as highlighted by many Living Lab researchers (Leminen, Westerlund, & Nyström, 2012; Schuurman, 2015; Ståhlbröst, 2008, 2012; Steen & van Bueren, 2017). The citizens interact with the innovation in their real-life context in order to co-create, design or test that digital innovation. The real-life context might be the citizens' home, workplace or any online environment. Within an ULL, the importance of cities and urban contexts as real-life setting is highlighted to a greater degree than in the Living Lab research.

Experimental. One of the main objectives of an ULL is to highlight interaction with the real-life setting in which innovative solutions are co-created in an urban experimental place. As Bulkeley *et al*. (2013) mentioned, an experimental governance for urban stakeholders is needed that enables them to co-create, develop and test innovative solutions regarding the urban challenges such as urban sustainability, climate change and resilience. In so doing, UNaLab employs multiple methods and techniques in order to engage citizens and other stakeholders to design and implement NBSs.

4.1.3 Key Stakeholders and Roles in ULL

In general we can say that an ULL follows the Quadruple Helix approach including public sector, academia, citizens, companies and the environment. These stakeholders can be divided into private actors such as citizens, visitors, inhabitants, refugees, micro-companies, SMEs and large enterprises and public actors such as cities, researchers, financers and government. However, having a more fine-grained approach, we have identified several roles that these stakeholders can take and roles that need to be included in ULL activities both internally and externally (Ståhlbröst, et al, 2015). The internal roles are important to consider while setting up and managing an ULL while the external roles are more important while managing ULL activities.

Internal roles:

The most apparent internal role that needs to be defined and engaged in ULL processes and activities is the **ULL manager.** This role has the responsibility to manage everyday practices of the ULL and also be the front-person of the ULL. In this role, the focus is on developing ULL projects and to ensure that the ULL is maintained and used by its intended users and that it creates value for the city in which it is implemented. This role is employed in the ULL and can be a person who covers more than one internal role. This role has a mutual dependency with the ULL.

One important role in the ULL is the ***human interaction specialist*** who is an important stakeholder to support an ULLs' processes. The relationship dependency between this role and

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the ULL is oftentimes mutual, since the human interaction specialist is interested in implementing user centered interactions and analysing the results from different human interaction methods. This role can either be employed by the ULL or be engaged on a project level. Viewed from the ULLs perspective, they are dependent on this roles' competence within the area of interacting with users and affectees. This role can be involved in activities such as planning the innovation process, designing concepts and principles, need-finding studies, testing and evaluating. In addition, this role also tests the solution prior to the implementation in the real world context to be able to design the process for experimentation for the people to be involved in the experimentation and feedback on the solution.

To facilitate the implementation and test of the innovation being developed in the project, one important role is the ***pilot manager.*** This role is involved in activities such as planning, coordinating and implementing real world experimentations that are centered on users and affectees. Hence, this stakeholder is very important for the ULL and can be employed by the ULL, but that is not always the case. The pilot manager has a strong and contractual relationship with the ULL and are mutually dependent on each other. This role involves many activities they need to master such as planning, building relationships and diffusing insights from interactions among the stakeholders. The pilot manager also coordinates the interaction between the other roles such as innovators, users, problem owners, and project manager when the pilots are being carried out.

One potential, but not always present role in an ULL is the ***panel manager***. This role can have the responsibility to recruit and interact with a panel of citizens, users, affectees and others being involved in test and evaluation activities. This role has a strong relationship with the ULL and can also be an internal part of the ULL, which puts them in a contractually bound relation with the ULL. The panel manager has the power to determine which users to involve in the process as well as how to interact with them in correspondence with the human interaction specialist. Thus, this role holds the key to the people being involved in the innovation process. Viewing this from one perspective it is positive that there is one contact point with the panel of users, and affectees in the pilots, since the total amount of interaction activities these citizen panels want to be exposed to are limited, hence having the panel open to anyone to interact with might lead to an overburdened panel. In addition, it is also important that the panel is interacted with professionally, hence having a panel manager who is responsible for the communication, invitations, privacy protection, etc. with the panel is a requirement to maintain a lively and healthy panel to interact with. The panel manager is involved in phases such as pre-studies and need-finding as well as test and evaluation. This role distributes information about experimental pilots externally and they also work in the background in the pilots. They plan and coordinate the interaction with the panel, they coordinate the communication between the different stakeholders involved in the process and they inform the other stakeholders of what is going on in the pilots.

The last role, but perhaps the most important role we have identified is the ***project manager***. This role is responsible for the management of a city development project as a whole, for instance, it can be a person employed by the city who is responsible for a larger development project in which the NBS is one part. This role might not be so heavily engaged in the ULL activities as such since the pilot manager usually manages these activities in communication with the project manager. This relationship is built on mutual dependencies since the ULL needs someone to drive the project, and the project manager needs an experimentation arena as well

as methodological support. The project manager often has the role of being the initiator who decides on potential actors to engage in a project.

External roles:

The most important role related to an ULL is the ***innovator*** who in the context of the UNaLab can be represented by a person who has the endeavour to develop an innovative NBS and wants to do this in the ULL. This person can be employed by the city, it can be an SME, a large company, an NGO or it can be a citizen. The innovator has a mutual power-dependence relationship with the ULL. This is visible in the innovators' power over the development of the innovation due to their possibility to determine what to include or not in the final design of the innovation as well as their power to determine when the innovation is ready for implementation and test. This role is usually involved in the process of development of use cases, development of the innovation as such, implementation of the innovation, testing and diffusion of research results to a broader community. Being involved in those core activities gives them a great deal of power to determine how the final solution should be developed and implemented into its context.

Another role that is typically involved in ULL activities is the ***user*** referring to those who should actually use the NBS when it is fully implemented. These users can be employees at the municipality, citizens or others using the final solution. These users contribute with contextual insights, their needs, values and goals related to a specific situation and solution. They can contribute to all phases in the ULL process with discussions and evaluations of ideas, concepts, prototypes and final solutions. The relationship between the ULL and this role is determined by the stakeholder, who also has the power to decide if they want to participate in the ULL activities. This role is important to the ULL and the involvement of users is usually driven by the ULL. Thus, if the user is not interested in collaborating or contributing to the ULL activities, the ULL usually has little power to influence that. However, users have something at risk by not contributing since involvement provides a means of having an impact on the solution that might be implemented in their city, i.e. they have a moral claim on the ULL.

In this deliverable, we make a distinction between users and ***affectees*** since this distinction is apparent in a city context where people can be affected by the implementation of the solution without being a user of it. The affectees are represented by the people living in the city or the people visiting the place where the NBS is implemented but without them really interacting with the solution. In the UNaLab project, the citizens and visitors might be directly or indirectly affected by someone else's use of the solution, but they will not be using the solution themselves, and they will not make decisions about the purchase of it, hence we suggest to use the concept of affectees to emphasise that these stakeholders have something at stake in terms of changes to their context, but they cannot directly influence the implementation or use of the final solution. These affectees have something important and valuable at stake in the solution, but usually, this role have no, or little voice in the development of it since they are not users or customers of the solution. Here, ULLs play an important role to strengthen their influence and to make their voice heard. This is usually a complex task since the affectees are loosely coupled with the ULL that has no power over the affectees and their actions. Hence, an important endeavor for the ULL is to find ways to stimulate these affectees to contribute to the design and development of the NBS even though they might not be aware of the innovation's existence in

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their city context. This role might also not be interested to contribute with their insights since they do not see a direct impact of their feedback on the solution since they are not directly involved in the innovation process. Due to the contemporary growth of the NBSs, this group can be expected to grow. Hence, affectees are important to involve in the ULL process due to their valuable insights regarding their needs, expectations and experiences related to the situation in which the solution will be implemented.

In this deliverable, we have also chosen to separate between users and ***problem owners,*** since a user can be one person, and the problem owners can be the city owning for instance a specific water problem. From the perspective of problem owners, contributing to the ULL activities becomes important since they want to get a solution to the problems they encounter in their context. The problem owners can also, in some cases, be the ones who trigger the initiation of ULL activities. The problem owner contributes to processes such as need-finding through their knowledge about the problem area. From the perspective of the problem owner, the dependency of the relationship between the problem owner and the ULL is mutual since both parties have an interest to solve the identified problem, which in a city context is often related to the city and its citizens.

The ULL also has ***financers*** as stakeholders, meaning the organization that funds the research and/or development of the NBS. In this project, the European Commission funds the research and development activities, in other cases the city as such can be the funder. Having research and innovation projects is also a common way to fund ULL activities in different domains. This means that the relationship dependency is stakeholder dominant since they have the power to stop the activities if they do not agree with the accomplished results in the project. They also have the power to decide which projects and activities to fund or not and the basis for legitimacy between the different parties are bounded by a contract. This stakeholder can also become a gatekeeper meaning that they are the one who possess the external resources for the ULL activities. This means that they have the power to influence what should be done and to some extent how it should be done. Being a financer also puts them in the position where they have an influence over the ULL actors' decision making process through project reviews and feedback.

The ***context provider*** is also an important stakeholder for ULL activities. This role is involved in implementation activities and the relationship dependencies with the ULL is role dominant since the context provider has the power to determine if they want to partake in the ULL activities, as well as how and where the NBS can be developed. In the UNaLab project, this stakeholder is manifested by the cities and their ownership of the land where the NBS are to be implemented. Thus, this role has a great deal of power over the ULL and its activities. This stakeholder can be understood also as a gatekeeper since they possess the real world context as a resource and if they do not wish to offer their context, the ULL has no power to convince them otherwise.

In sum, in ULL there are many different stakeholders and roles that need to be engaged and involved in the process of managing ULL experimentation. Important to note during the process of setting up an ULL is to keep track of which external and internal roles and stakeholders should be engaged and perhaps involved as partners in the ULL.

4.2 Suggestions on how to set up and run an ULL

By considering the key components, principles and stakeholders of an ULL, and in order to better understand how to set up and run an ULL, an initial ULL framework is developed and presented in this deliverable. This framework will be updated in future versions based on experiences and input gained from the cities involved in UNaLab. Figure 10 shows an overall view of this presented model. In the following section, each of the elements of this model in relation to setting up and running an ULL are discussed in greater detail.

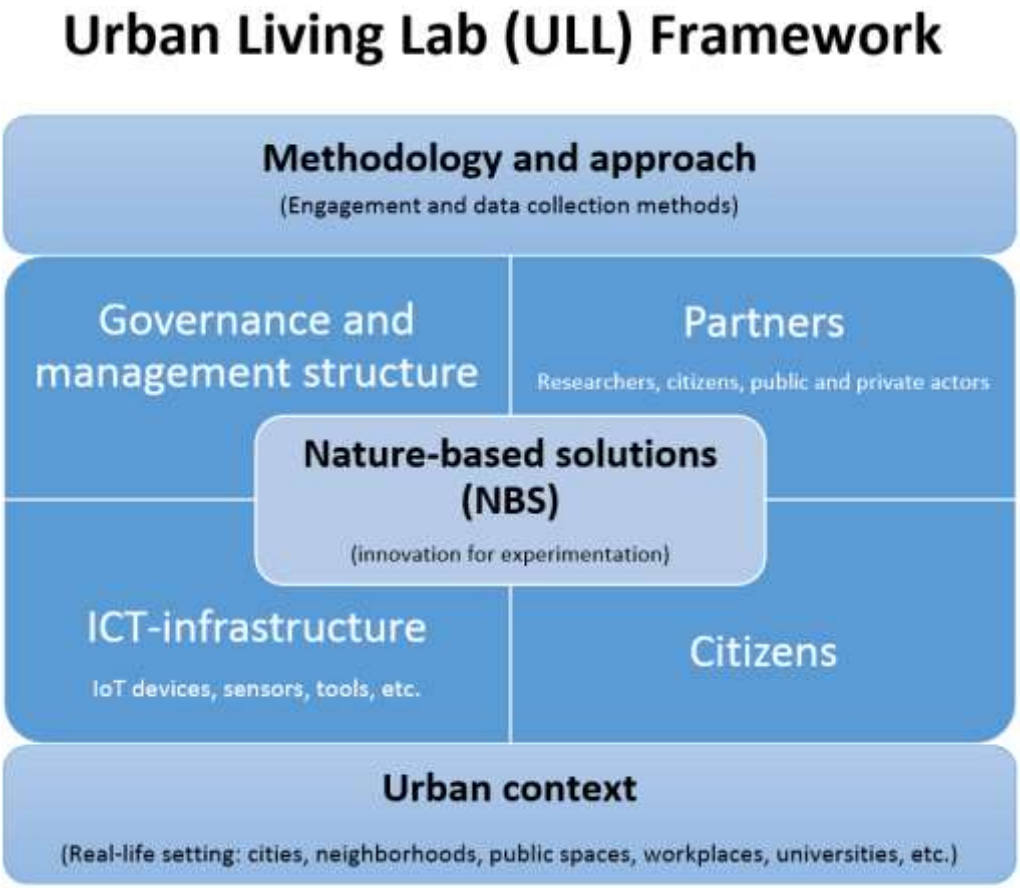

Figure 8 An Urban Living Lab (ULL) Framework

4.2.1 Key component 1: NBS/innovation to experiment with in the ULL

Most innovations emerge from gaps between existing solutions and human expectations. This process can be driven by the technological possibilities, societal needs, human needs or an inventor's visions. Thus, to innovate means to create something new and different and to be creative. These innovations can be services, products, processes and/or brands, but in general it means that a need is met by new means.

Working with innovations is expensive, risky and time consuming. Additionally, the work with innovation is unpredictable. Due to this, it is important to decrease these factors and to create opportunities for success for the innovation. In the ULL this means to have structured and well-

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considered processes to support the experimentation process with the innovation. This is one of the main objectives of an ULL.

When setting up and running an ULL it is also important to understand the innovation(s) and the NBS to have a viable and sustainable ULL. In ULL settings, it is very important to have an innovation to experiment with and which contributes to some societal challenge. In this context, an innovation should create some value for its stakeholders and it should be developed by active stakeholder participation and by using multiple-methods.

To support this process, a matrix is presented showing questions that need to be asked as the ULL is set up but also during the management process of the ULL. For each time a NBS or innovation will be experimented with in the ULL these questions need to be asked and developed to ensure that the innovation is fully understood and the results from the experimentation process are captured accordingly. This framework can be used as support to plan each experimentation process with an innovation in the ULL (see Table 1).

Table 1 Key component 1: NBS/innovation to experiment with in the ULL

Questions NBS and/or name of innovation	What is the innovation?	What is the aim of the innovation (what value does it create)?	For whom does it create value?	What will be experimented with?	Who can experiment with the NBS?	How can they experiment with it, which activities will they do?	Who will benefit from the experiment?	How will the results from the experiment be captured?

The results from the clarification of these questions gives a starting point in understanding the innovation to be elaborated with in the ULL and if there are no innovations to begin with while setting up the ULL, the following questions could be asked:

- What type of innovations would we like to experiment with in the ULL?
- What value do we want to create with the innovation our ULL should experiment with?
- For whom do we want to create value with the innovation?

4.2.2 Key-component 2: Context – physical setting for the NBS and the concept of place

In an ULL it is important to know the physical setting in which the NBS will be implemented to be able to develop a NBS that supports the context. In this process it is important to get a view of the physical prerequisites for the context and its potential. Here, answering these questions and analyzing the possibilities and challenges in the context is relevant from an ULL perspective. A place is formed both by its physical environment and by the pattern of events that people experience there. It is important to gain insights into features of a place: geographical location, material form, and investment in value and meaning. Hence, when it comes to understanding and designing environments of different types, we need to focus equally on their location, the structure of the environments, and on the activities that take place there (see Table 2).

Table 2 Key-component 2: Context – physical setting for the NBS and the concept of place

Question	Answer	Possibilities	Challenges
Where is the physical setting?			
Who owns the setting? E.g. who can stop the process			
Who has access to it? Is it open or restricted?			
Which physical infrastructure is available? Streets, electricity, local transports etc			
Which technical infrastructure is there available in the context? E.g. fibre, wifi, 4G, sensors			
What are the contextual conditions that needs to be considered? E.g. damp, polluted, forest, etc			
What are the future plans for the context? Are there any and who has them?			
Who has the responsibility over the context? E.g. physical security			
Which activities does the environment currently support and for whom?			

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4.2.3 Key component 3: Governance and Management of the ULL

The ULL has the aim to contribute to increased public value, which can take the form of economic, social and ecological value, both in public and private contexts. In these real-life implementation of innovations in urban contexts, local governments and other stakeholders who aims to gain insights into new ways of handling societal challenges.

Currently, cities need to reflect on their governance strategies to find new ways of handling the growing number of complex societal challenges. Governance includes a set of actors from business to civil society and puts emphasis on social processes rather than on the state.

Developing the governance and management model for an ULL requires some activities to be performed and decisions to be made in order to form the best model for the ULL. Hence, to set up the governance model and management of the ULL, highlighted steps below (Figure 9) have to be discussed and elaborated.

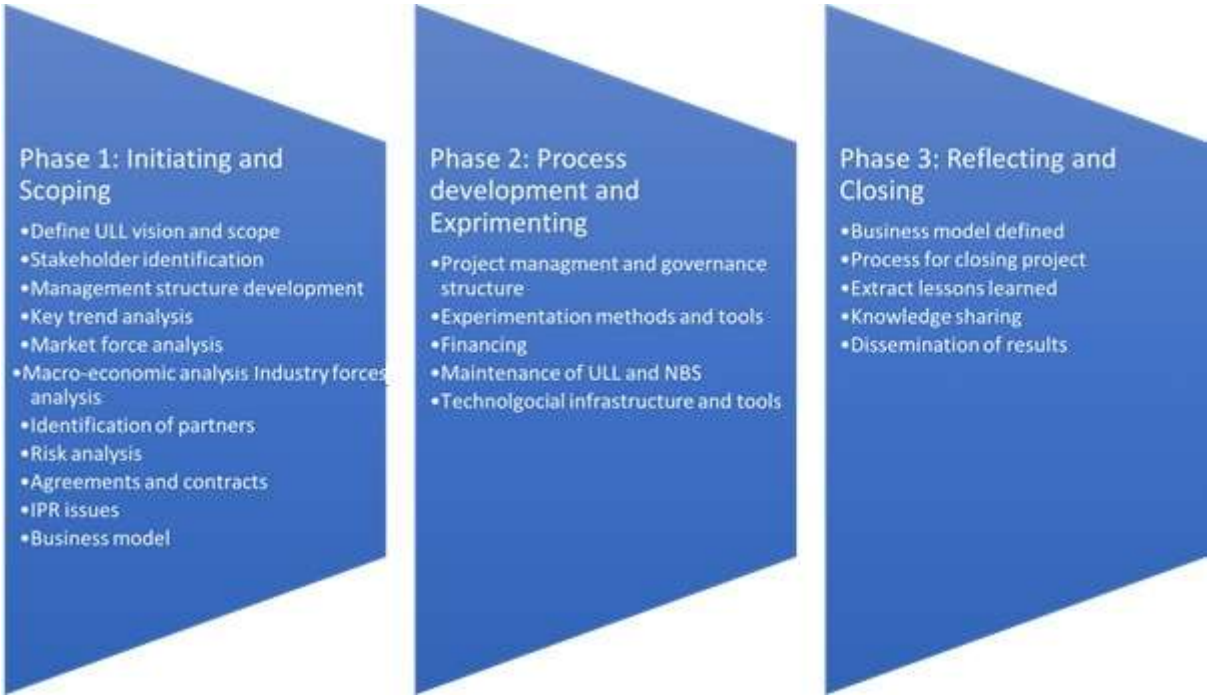

Figure 9 Phases for Governance and Management of ULL

Phase 1: Initiating and Scoping: This element of ULL focuses on defining the aim of the ULL and its vision as well as identifying the central actors of the ULL, common strategies and concrete agendas for ULL experiments. In ULL processes it is important to combine top-down and bottom-up approaches. In this way, top-down levels (e.g. a small ULL task-force) can propose a few critical values as a basis for the discussion about NBS. By using innovative communication methods, bottom-up involvement of a wider group of stakeholders and partners can complement the discussion. The aim of this process is to both monitor the wider environment for the ULL as well as develop internal visions and strategies for the ULL.

Phase 2: Process Design and Experimenting: This element of the ULL focuses on defining the approach and process supporting the innovation process and approach defined under the key component "Approach". In this element, the aim is to define how the supporting structures should be designed, e.g. what starts an ULL process, who handles it, who has responsibility to engage with stakeholders, who can write contracts, how will the experiment be financed, etc. All these questions need to be answered to define an organizational management model for the ULL. In this process, an ULL can benefit from including stakeholders with different worldviews and opinions. An ULL must support failures and learning processes since innovation and experimentation is about trying things that have not been elaborated earlier and thus, the likelihood for failure is relatively high. Hence, learning and reflecting on the processes and outcomes is of utmost importance.

Phase 3: Reflecting and Closing

ULL experiments are time-limited, innovative and should have specific, pre-defined learning objectives that can be monitored and evaluated. In this phase, experiences should be tested and included in forthcoming experiments by scaling up, broadening, and deepening. Deepening refers to deep learning, broadening to repeating an experiment in another context and to link it with other issues, and scaling-up to fostering institutional embedding. By reflexive learning, there is a societal, integrative development process.

The greatest challenge for transition experiments is to identify lessons learned and disseminate the results from the ULL to city planners and embed them in urban governance structures. The active involvement of city planners in the choice, design and evaluation of local experiments for urban governance is one way of achieving this.

These suggested elements of ULL are not necessarily following a specific order. Rather they can be regarded as different components of an iterative (co-creative) process. Therefore, learning and embedding lead to new agenda setting, process design and experimenting (e.g. when a lab is being evaluated, closing down, starting a new round of funding, etc.). After finalizing an ULL project it is also important to close the project, report on the findings, reflect on the lessons learned and disseminate the results from the project to ensure that knowledge is shared and the business model is defined.

4.2.4 Key-component 4: ICT-infrastructure

ULL activities are usually carried out in multiple contexts that are distributed and in real world contexts. This means that it is important to have supportive tools and technical infrastructures to be able to communicate, interact and engage with the stakeholders that are engaged in the ULL activities. An ICT infrastructure that should support ULL activities benefit from using multiple channels and both innovative and traditional systems. This means that traditional ICT channels supporting the ULL should be used by the city. This can for instance be through the city's website, social media channels or other channels.

To identify both existing and desirable ICT tools and infrastructures, it is important to map out the technological landscape, its needs, and stakeholders. To support this process, the matrix below can be used (Table 3).

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Table 3 Key-component 4: ICT-infrastructure

Technology	What is it	Who use it	Where do they use it	Why do they use it
Hardware				
Software				
Data				
Network				

4.2.5 Key component 5: Citizens

Within an ULL, engaging citizens in the innovation process is of crucial importance. Accordingly, in the UNaLab project, citizens with different roles must be engaged when it comes to designing, co-creating, testing and evaluating NBSs. Citizens might be visitors in the area where the NBSs are developed. They could either be actively or passively involved in the innovation process. As previously mentioned, citizens with passive role can be considered as affectees who are affected by the innovation or solution.

Other factors to successfully engage citizens in an ULL are to understand how to communicate with them, how to engage them and how to keep them engaged throughout the whole development and innovation process. The drivers to engage citizens are also different depending to the roles and degree of engagement in the innovation process. In an ULL, the role of citizens can be different, such as: experimenters, innovators, lead participants, co-creators, and finally citizens as co-testers and evaluators.

Accordingly, in order to set up and run an ULL, multiple questions should be considered when it comes to engaging citizens in the development and innovation process of NBSs. The following table (Table 4) shows an overview of these questions for citizens who are engaged in an ULL that might have different roles in the process of development and innovation of NBSs.

Table 4 : Key-component 5: Citizens

Roles →	Affectees (passive role)	Experimenter	Innovator	Lead participants	Tester/ evaluator
Drivers					
Degree of influence					
Level of expertise					
Where to find them?					
How to engage them?					
How to motivate them?					
How to keep them motivated?					
What kind of activities are they involved in?					
How they affect the innovation process?					
How they are affected by the innovation?					

4.2.6 Key component 6: Partners and stakeholders in the ULL

In general, an ULL follows the Quinto Helix approach including stakeholder groups such as: public sector, academia, citizens, companies and the environment. These stakeholders are divided into private actors such as citizens, visitors, inhabitants, refugees, micro-companies, SMEs and large enterprises and public actors such as cities, researchers and government. In an ULL, the following stakeholder groups should be considered and potentially involved in ULL activities: (1) an innovator (brings the idea); (2) a human interaction specialist (to support the process); (3) the users (of the NBS); (4) the affectees (affected by the solution); (5) the problem owner (e.g. the city); (6) financiers (bringing funds); (7) a pilot manager (facilitating

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implementation and testing); (8) the panel manager (responsible for interaction activities); (9) context provider (involved in implementation activities and the relationship dependencies); and, (10) a project manager (responsible for the project management).

To develop a sustainable and viable ULL, the stakeholders need to be analyzed and connected. Table 5 shows some of the main stakeholders and criteria that can be used in order to create a map of *who* the stakeholders are and their role in the ULL.

Table 5 Key component 6: Partners and stakeholders in the ULL

Stakeholder	Objective /Focus (technical, organizational, commercial)	Drivers/ Motivation (innovation, governance, infrastructure)	Resource owner of (monetary, knowledge, competence, technology etc)	Involvement in issue (High-Low)	Influence/ Power (High-Low)	Alliances	Member-ship models	Legal bounding (e.g. IPRs)	Leader-ship
Individual									
Citizen									
Visitors									
Users									
Practitioner									
Decision-maker									
Researcher									
Private org.									
Micro-company									
SME									

Large enterprises									
Public org.									
Public institutions									
Policy makers									
Local government									
Academia									
Other									
Research institute									
Funding agencies/ Financiers									
Sponsors									
Associations									
Interest groups									
Etc.									

Objective /Focus (technical, organizational, commercial): the stakeholder's objective and interest in ULL participation. What parts will the stakeholder be involved in?

Drivers/ Motivation (innovation, governance, infrastructure): the stakeholder's key drivers to be involved.

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Resource owner (monetary, knowledge, competence, technology etc.): the quantity of resources—human, financial, technological, political, and other—available to the stakeholder and his or her ability to mobilize them.

Involvement in issue (High-Low): The stakeholder's engagement in the ULL.

Influence/ Power (High-Low): the ability of the stakeholder to affect the implementation of the ULL.

Alliances: organizations that collaborate to support or oppose the ULL. Alliances can make a weak stakeholder stronger, or provide a way to influence several stakeholders by dealing with one key stakeholder.

Membership models: the stakeholder's preferred way to be part of the ULL, benefits/offerings in relation to costs/efforts.

Legal bounding (e.g. IPRs): the stakeholder's type of legal bounding, contracts.

Leadership: the willingness to initiate, organize, govern, etc. the ULL.

4.2.7 Key component 7: Approach and methodology

An ULL approach outlines the experiments that are conducted for socio-technical innovation in an urban context. Accordingly, the NBSs are developed in a collaborative manner in which citizens, researchers, decision-makers and practitioners are involved in data collection and experimentation in an iterative and long-term process. Each ULL has its own approach to develop solutions and innovations. Therefore, he way of setting up and running an ULL differs in different Living Labs.

In order to provide guidelines on how to set up and run an ULL, we have employed FormIT approach as a well-established Living Lab methodology to facilitate development of innovations and support various ULL activities. Accordingly, four major phases are considered as the main steps namely, explore, create, implement and evaluate. The key principles of an ULL (namely, societal and value creating, open and inclusive, explorative, responsible and sustainable, real life context, and experimental) should be kept in mind and strictly adhered while conducting each phase of innovation process within an ULL.

Table 6 shows an overall view of the main phases of the innovation process in an ULL by considering the key principles of an ULL. Some example questions for each phase are also presented.

Table 6 Key component 7: Approach and methodology

Phase / Principle	Explore	Create/Design	Implement	Evaluate
Open and inclusive	Is it based on open calls? Is it disseminated in public channels?	Is the innovation co-created and co-designed in an open and inclusive approach?		Is the test plan open for citizens to participate?
Explorative	Is a relaxed atmosphere to begin idea exploration created? Are concrete materials to begin idea exploration provided?	Is the innovation co-created in an explorative environment?	Is the innovation implemented in an explorative environment?	Is the test and evaluation process explorative in nature?
Responsible and sustainable	Is the generated idea in line with sustainability considerations?		Are new or improved resource efficient strategies to implement sustainable innovation considered in the process?	What ethical considerations during the test and evaluation process need to be handled?
Real life context		How the innovation process should be designed to capture as realistic	Is the context that the innovation planned to be implemented a real-life	Are citizens able to test and evaluate the innovation or solution in their real-life

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		situation?	context?	everyday use context?
Societal and value creating	Does it stimulate creativity and support generating new ideas? Does it contribute to societal and social needs?	Is the value co-creation in collaboration between different stakeholders in design process is considered?		
Experimental	Is the innovation exploration based on a collaborative experimentation of researchers, citizens, companies and local governments?		Are there geographically embedded spaces that facilitate explicit experimentation and learning based on participation and user involvement?	Are multiple test and evaluation methods employed in the process?

4.2.8 Tests and Evaluations

This section presents the initial plan to test and evaluate NBSs in the UNaLab project. An introduction to the Living Lab field test, overall methodology for test and evaluation, data collection methods, test and evaluation process as well as motivational factors are discussed in this section.

What is a Living Lab field test?

Within Living Lab approach, a major principle is to capture the real-life context which an innovation is used by citizens by means of a multi-method approach (Bergvall-Kåreborn, Eriksson, & Ståhlbröst, 2015; Schuurman, 2015). When it comes to an ULL environment, engaging citizens in the process of innovation might be associated with different activities such as ideation, design, development and finally test and evaluation. In general, Living Lab studies have an implicit tendency to focus more on the process of test and evaluation and testing a product, service and system has always been one of the key activities in Living Lab research and projects (Claude, Ginestet, Bonhomme, Moulène, & Escadeillas, 2017). The main differences between the traditional way of testing and evaluating products, services and systems and Living Lab tests is that in a Living Lab test setting, the process of test and evaluation is not

usually under controlled situation. Instead, the citizens interact with an innovation in their real-life everyday use context while testing and evaluating it (Georges, Schuurman, & Vervoort, 2016). In the UNaLab project, the test and evaluation environment is a real urban context in which citizens are the key factors to test and evaluate the NBSs. Accordingly, the test and evaluation process in an ULL and particularly in the UNaLab project will be highly visible as the citizens are engaged to test and evaluate the NBSs in their real life everyday use context.

The most common approach to engage citizens in the Living Lab activities in the test and evaluation process is field testing. Although there is not a clear, concise and well-accepted definition for Living Lab field test in Living Lab literature, different dictionaries have provided definitions for the term "field test". According to Merriam-Webster Dictionary (2008), the aim of conducting a field test is "to test (a procedure, a product, etc.) in actual situations reflecting intended use". Thus, field test should be done in the real-life setting. Capturing the real-life context is associated with 'realism', which is one of the key principles in Living Lab activities in general and test and evaluation phase (Ståhlbröst, 2012). In the ULL context, the whole city might be considered as the test platform in which the prototypes, innovations, systems and service are tested and evaluated and all stakeholders including citizens are engaged to interact with the NBSs to test and evaluate them.

Overall Methodology

For the test and evaluation of NBSs, the FormIT methodology as a well-established Living Lab methodology is selected and explained. According to the FormIT methodology which is developed to suit and support Living Lab activities, there are three iterative cycles in the innovation process: concept design cycle, prototype design cycle, and innovation design cycle (Ståhlbröst, 2008). Test and evaluation phases are associated with the third cycle, i.e., innovation design that in turn, consists of three phases: appreciate opportunities, design innovation, and evaluate user experiences. Figure 8 shows the FormIT methodology and its cycles and iterations. This approach is suitable for test and evaluation of NBSs since within the UNaLab project, the NBSs need to be continuously improved and the evaluation phase in the FormIT methodology highlights this aspect by engaging citizens in the test and evaluation process.

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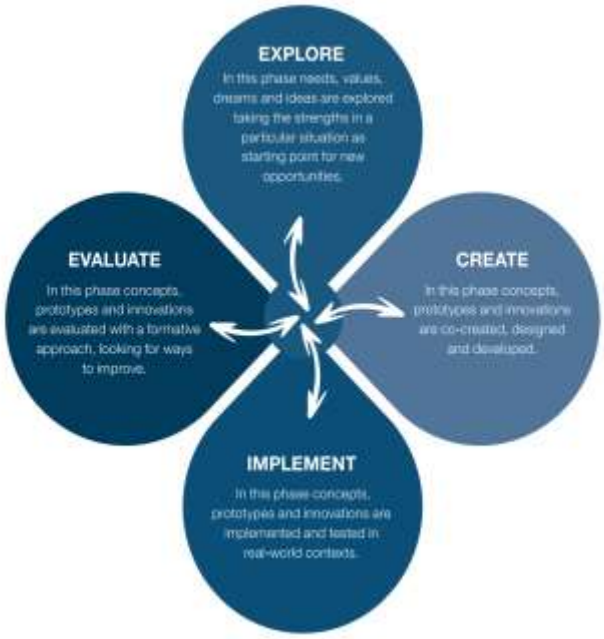

Figure 10 FormIT – A Living Lab Methodology (Ståhlbröst, 2008)

In the 'Living Lab methodology handbook' published by Botnia Living Lab in Sweden, it is recommended to develop a "test-storyline" to support the citizens in their test showing what is expected from them. These steps are:

- Activities they must do, for example, number of surveys, typical tasks, use of certain functionality, etc.
- Activities they can expect from the living lab organizers.
- Frequency of use
- Test-period, for how long will the test lasts
- Time required from them

Accordingly, the test and evaluation activities in UNaLab are part of an iterative testing and feedback process. Like other activities in Living Labs such as co-design and co-creation where users are one of the key stakeholders, within the test and evaluation process, the users also should be co-testers (Tang & Hämäläinen, 2012), particularly in an ULL where the citizens are at the center of attention. Therefore, citizens need to be motivated and encouraged to be active participants in the test and evaluation process. Active participation is the key principle that differentiates citizen engagement in an ULL from traditional test beds where users are considered as an actor instead of being an influential factor in the test and evaluation process.

Data collection methods

An appropriate research methodology for conducting Living Lab field tests is the methodology that facilitates more involvement between the researchers and citizens in the research. According to Maxwell (2012), qualitative research is more appropriate when it is important to understand the phenomena from the participants' point of view and particularly when it comes to social and institutional context. Within qualitative research, instead of providing a specific setting to conduct the study, individuals are typically involved in their natural setting (Kaplan & Maxwell, 2005); which is in line with the nature of Living Lab activities and more particularly an ULL in which the whole city is considered as the NBS development platform.

According to Kaplan and Maxwell (2005), qualitative data may be gathered using three main sources namely: 1) observation; 2) semi-structured interviews and open-ended questionnaires; and 3) documents and texts. Accordingly, in order to conduct field tests in the Living Lab setting, these methods can be used to collect qualitative data. Within the UNaLab project, feedback from the citizens and test participants about their experiences while testing and evaluating the prototypes, innovations and NBSs will be collected and reported.

Observation is one of the most common qualitative methods of data collection in the individuals' natural setting (Flick, 2009; Kaplan & Maxwell, 2005). Moreover, direct observation of citizens and their behavior as well as interaction with them during their engagement period regarding information about how to carry out the assigned tasks, technical problems that occurred during the field test, and other problems they experienced are valuable sources of data and would be necessary to identify and understand the influential factors on the success and outcome of Living Lab field tests. On the other hand, this method is generally more appropriate when the area of application is open environments (Adler & Adler, 1994). As studies on open innovation have increasingly emphasized the role of individual users as collaborators in the innovation processes in open environments (Chesbrough, 2006), the degree of openness is an influential factor on the process of test and evaluation in Living Lab environments. Within an ULL, the aspect of openness becomes more apparent since the test and evaluation environment is an urban context.

Regarding the questionnaire, some researchers (such as Flick, 2009) consider open-ended questionnaires a way of combining qualitative and quantitative methodologies. Currie (2003) argues that in some cases, the reliability of qualitative data which are collected using open-ended questionnaires is higher than semi-structured interviews. The reason is that all respondents should answer the same questions and also they have this opportunity to add some supplementary information. Therefore, the open-ended questionnaire can be considered an alternative for semi-structured interviews in specific situations. Witzel (2000) recommends that, before the interview, it would be beneficial that an open-ended questionnaire is used to collect data. This approach will help the researchers to develop the interview protocol and helps methodological triangulation (Flick, 2009). When the test and evaluation environment is the city, open-ended questionnaire can be an appropriate alternative to collect citizens' feedback in the UNaLab project.

According to Kvale (1983), semi-structured interview is the most common and powerful way of data collection within phenomenological research. In contrast to participant observation that is based on the researcher's interpretation, semi-structured interview concerns the experiences of the respondents in their own words (Kaplan & Maxwell, 2005). It will be useful since the citizens and end-users are at the center of attention and analysis when it comes to Living Lab field tests. This type of interview is mainly based on the open-ended questions. The previous knowledge about the field test will guide the researchers to better understand how they should formulate the questions.

Test and evaluation process

There are different activities required to conduct a field test in a Living Lab setting. In the UNaLab project, these activities might be:

1. Defining tasks that are possible to be accomplished in the citizen's real life environment.
2. Turn tasks into appropriate scenarios.
3. Finding and recruiting citizens who are motivated enough to participate in the process of test and evaluation of prototypes, systems, services and NBSs.

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4. Capture insights from the test and evaluation process.
5. Sending feedback to the developers and ULL organizers.
6. Iterate the test and evaluation phase by improving, testing again and validating the test results.

Multiple questions should be answered to have a successful test in a Living Lab setting. The questions such as:

- First evaluation: 'Should we conduct tests for this prototype now?'
- Method selection: 'How should we conduct the field tests?'
- Resource allocation: 'What resources do we need and how do we use them?'
- User recruitment: 'How many users should be involved and how do we motivate them?'
- Setting: 'In what environment or situation should we conduct the field tests?'
- Analysis: 'What can we learn from the feedback we have received?'
- Final evaluation 'Is this prototype appealing to or required by the elderly?' or 'What can we do to improve this prototype?' (Kang, 2012).

Motivational factors

Conducting field tests in the Living Lab setting is challenging and there are several issues that need to be considered. The challenges such as motivating citizens to participate in the Living Lab field tests and keeping them motivated throughout the whole process of test and evaluation are known as important challenges while conducting a field test. Considering Living Labs as a socio-technical system, these challenges might be related to the social, technical and socio-technical aspects.

According to the factors that either positively or negatively influence users' motivation, Habibipour & Bergvall-Kåreborn (2016) presented a user engagement model that can be used to better engage citizens in the process of test and evaluation in a Living Lab setting. Figure 11 shows this user engagement process model and various factors that are influential to sustainable user engagement.

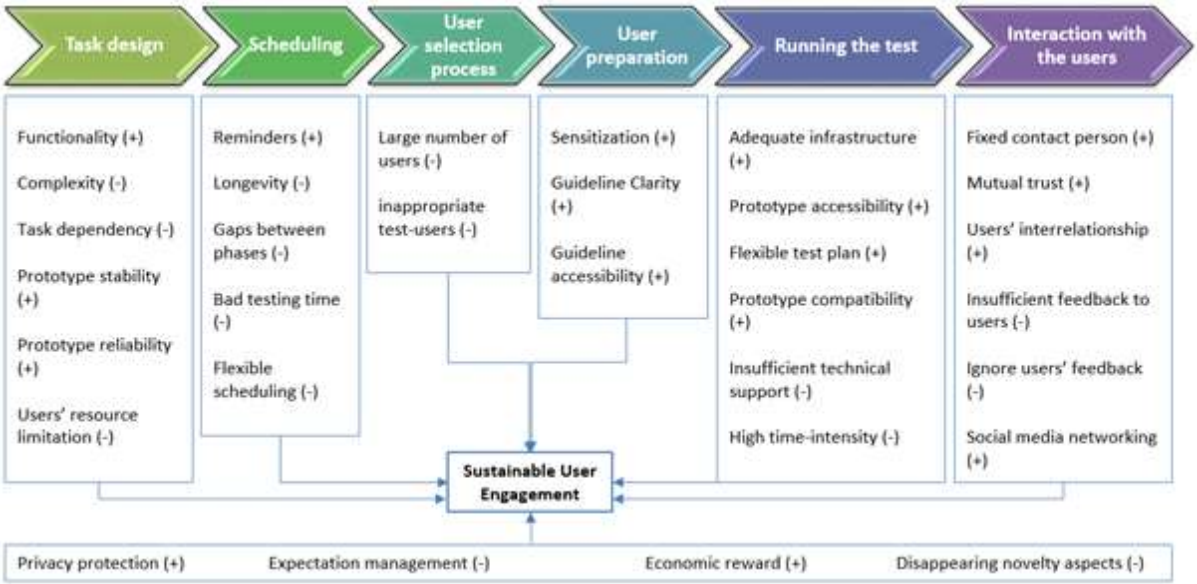

Figure 11 A Process Model for Test and evaluation (Habibipour & Bergvall-Kåreborn, 2016)

When it comes to the technical factors influence the motivation of citizens within Living Lab field tests, factors related to the innovation itself are highly influential. Technological problems,

perceived ease of use and perceived usefulness are the group of items that are associated with technology in which the innovation plays the central role in this theme. When it comes to social aspects, environmental context such as citizens' everyday context and their resources are more influential on their motivation. Accordingly, social aspects are more related to the citizens and their personal context. Regarding the socio-technical aspects, the way of organizing the Living Lab research and setting, communication and interaction between different stakeholders, designing the tasks and timing are influential on users' motivation (Habibipour et al., 2017). These factors are of crucial importance in the UNaLab project as the citizens are the key factors that can affect the innovation process specially when the NBSs are tested and evaluated in the urban context.

5. PLAN FOR TRAINING PROGRAM

In the following section a plan for the training program in ULL is presented. This section includes a timeline for the training program as well as its structure.

5.1 Training Plan

The aim of the Urban Living Lab training is to support UNaLab front-runner cities in setting up and running their Urban Living Labs, as well as providing the follower cities with guidance, tools and methodologies through the process. ULL methodologies and tools are utilized in defining, testing, evaluating and implementing NBS in a co-creative manner. By involving all the stakeholders throughout the process, from public, private and academic institutions as well as the citizens themselves, the ULL methodology facilitates a structured, iterative decision-making process for the successful implementation of NBS.

Living Lab methodologies are iterative by nature, context dependent and adaptable to suit current and changing needs. To this aim, the ULL training consists of both training the cities in ULL methodologies and tools, operations and management, as well as consultation and feedback to understand the current needs of the cities in forming the next steps of the training. To facilitate reciprocal learning between the trainer and the trainee, the training plan has been formed as an indicative framework rather than a strictly defined plan. This approach allows for an iterative process throughout the training where the input from the front-runner cities, as well as follower cities, can be considered in adapting the training program, materials and tools throughout time.

5.1.1 Timeplan and Activities

The Living Lab training and evaluation (T2.4) takes place over the course of three years. During the first year activities are based primarily on defining the skeleton for the training plan while scoping the needs of the front-runner cities and follower cities. The first draft of the ULL framework (T2.2) marks M9 of the first year, setting the stage for the first local training workshops at the front-runner cities taking place around M12.

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The timeline presents a biannual planning for the ULL training, dividing the ULL training into periodic phases. The first period (scoping) runs from M1-M6, the second period (defining) from M7-M12, third period (adapting) from M13-M18, fourth period (refining) from M19-M24, fifth period (implementing) from M25-M30 and the sixth period (evaluating) from M30-M36. The phases presented in this plan are designed to be followed in an iterative rather than linear manner – each phase representing the main focus of that phase while all activities represented below may also be present in all of the phases (see Figure 12).

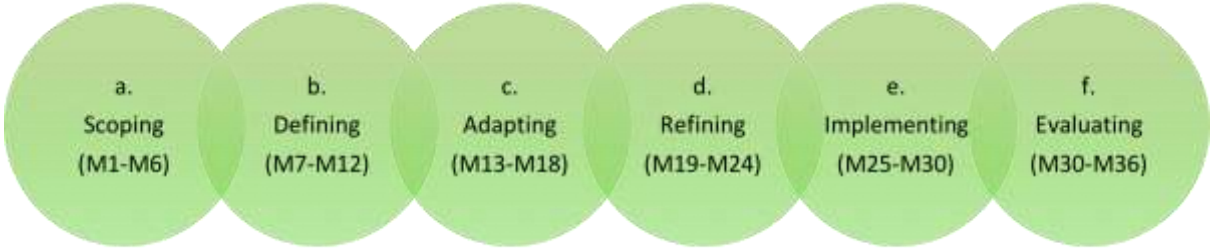

Figure 12 Timeplan for UNaLab training program

Scoping

Scoping is the first activity in the series. This entails initial research into the topic area, understanding the context of the project and the cities involved. During the scoping period, initial ideas were formed on the needs for the training.

The first activity of the ULL training with the cities was carried out during the UNaLab Consortium Meeting in Genova, Italy (November 21-23 2017). The key components, as represented in the key components chapter of this document, were transformed into discussion templates where each respective UNaLab project front-runner and follower city led the discussions of their tables. This training activity educated the participants on the key components of ULL and facilitated peer-to-peer learning through the discussion of the templates, while also collecting the necessary feedback on the current level of knowledge and needs for the next steps in the training by identifying key components that posed most difficulties for the cities.

Additionally, to consult with the cities on their needs for the training, the scoping period has consisted of planning for the training, considering the activities throughout the UNaLab project overall. The timeline has considered the relevant activities from across the different work packages and tasks. The relationship between the ULL training and the EASW and Design Thinking workshops and subsequent activities have also been considered in the planning.

In the context of the project, during this phase a selection of different types of NBS were explored and presented at the Consortium Meeting in Genova, Italy. Their applicability in the context of the cities was discussed.

Defining

Following the initial scoping according to the project plan and the needs of the cities, an initial ULL framework is formed in M9 (T2.2 – D2.1). This framework presents the first draft of the ULL framework and the training plan. Simultaneously, the gathering of knowledge materials for the ULL toolkit begins, further defining the scope of the ULL training. The first prototype of the ULL toolkit in M12 is utilized in the first training workshops with the cities in the next phase: adapting.

In the context of the project, the EASW and Design Thinking training workshops are taking place during this phase. These trainings provide the cities with established workshop methodologies to guide their activities to include scoping, such as need finding, as well as defining, such as problem definition.

Adapting

The third period consists of the first set of training workshops conducted at the three front-runner cities. Utilizing resources from the ULL toolkit prototyped during the previous phase, these trainings aim to further advance the front-runner cities' knowledge of and capabilities with ULL methods and tools. Aiming for reciprocal learning during these trainings, the feedback from the cities will input to the adaptation of the next steps in the training plan as well as the ULL toolkit.

A second training workshop is planned in M15 in Geneva, Switzerland (21 August 2018), where all UNaLab cities are invited to join. This training will focus on the insights gathered from the first round of trainings with the front-runner cities and further converge into the topic areas identified as important through the feedback gathered.

During this phase the ULL toolkit is being tested by the cities, providing important feedback for the further adaptation of the toolkit and to determine the key insights for the next phase in the plan: refining.

Refining

Based on the learnings from the first set of training workshops and feedback on the ULL toolkit, the refining phase will focus on further strengthening the cities' knowledge on topic areas identified as important next steps. By this time, the training will also focus closely on ULL set-up and management, moving from training in methodologies and tools to training on operational structures and practices. The aim of the training in this phase is therefore focusing on creating sustainable ULLs with the necessary governance models in place. The ULL trainings as well as the EASW and Design Thinking workshops are completed by the end of this phase in M24, after which the implementation and evaluation phases will follow.

Implementing

In the beginning of this phase the trainings and workshops have been concluded and the project will focus on implementation of co-created NBS. To support this phase the ULL training will provide guidance in co-implementation and co-evaluation, i.e. critically assessing the implemented measures together with all stakeholders involved. Co-creation methods and tools involved with these latter phases of the project are also explored, such as crowdsourcing or crowdfunding, community building and panel management, for example. By the end of this phase the final version of the ULL toolkit is released in M30, including methods and tools for all phases throughout the process.

Evaluating

During the final phase, all support provided by the ULL training is in place and being assessed in terms of the support provided to the cities and impact achieved. This evaluation will inform the UNaLab Living Lab handbook (D2.4) due in M36.

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6. UNALAB WORKSHOP REPORTING

In this section, we will give a summary of the workshop carried out at the UNaLab meeting in Genova, Italy in November 2017. We will present the workshop structure, show examples of the templates that were used to support the workshop and a presentation of the results from the workshop.

6.1 Introduction

In order to explore different perspectives of urban Living Labs, a workshop was convened in Genova, Italy in November 2017, with seven UNaLab project partners to deepen the participant's knowledge on the topic of ULL while at the same time gathering information on the topic and capturing their perspective as the city representative in the UNaLab project. Three UNaLab front-runner cities i.e., Genova, Tampere and Eindhoven and four follower cities i.e., Cannes, Stavanger, Prague and Basaksehir participated in this workshop.

6.2 Workshop Setting

First, an introductory presentation provided the necessary background information in what is an ULL. Then, participants were split into eight tables: each city (front-runner and follower) hosted their own tables. The table groups proceeded to fill in the six templates (see Figure 12), and debriefed the results of these templates to the entire room at the end.

The workshop was organized as follows:

1) **Introductory presentation: what is ULL, what are the key components of an ULL**
2) **Template 1: What is an Urban Living Lab?**

    a. **Definition: what is your perspective on ULL? What is it?**

    Participants were asked to write down their definitions for Urban Living Labs by writing on post-it's the key elements that should be present in an ULL

    b. **Objective: What is the objective of the ULL? What should it accomplish?**

    Describing the goal of the ULL by writing down, on post-its, what the ULL should ultimately achieve

3) **Template 2: An innovation to experiment with or create**

    a. **Challenge: what is the problem or challenge you are aiming to solve?**

    Focusing on the challenge or problem statement, participants were asked to discuss the challenges that the ULL is aiming to solve through NBS

4) **Template 3: An urban context to experiment in**

    a. **Street – District – City**

    Writing down details about the experiment(s) that the cities are planning to conduct, and placing these experiments onto the template based on geographical scale – is the experiment performed on a street, district or city scale

5) **Template 4: Engaging citizens**

a. Who

Writing down key stakeholders on post-its, participants were asked to place these onto circles according to how central the role of these stakeholders are in their ULL

b. Why / When / How

If time allows, participants could also think about why they are engaging these stakeholders, when and how

6) **Template 5: A mix of methods for engagement**

a. Evaluation and research, experimentation and piloting, implementation and upscaling

Writing down different ideas for engagement activities, participants were asked to place these onto the template according to the phase in which they are planning to conduct these activities: are the workshops planned for the beginning phase to find out more about the stakeholders, or for the experimentation phase to test out solutions? Etc.

7) **Template 6: Management structure for the governance of the ULL**

a. People: who starts the process, who answers the request, who is responsible to run the experimentation process, who makes decisions to go or no-go, who is the receiver of the process?

Answering the questions above, participants were guided to think closely about the management structures and human resources issues concerning their ULL

b. Organisational models: financing, documentation and evaluation, host organisation

Answering to the items above, participants were guided to think closely about the models of governance of the ULL in the wider context

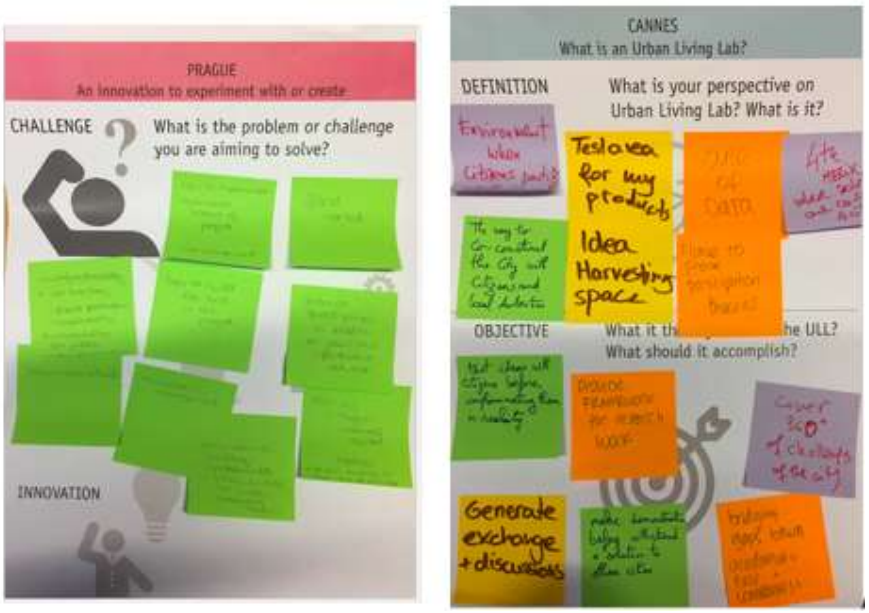

Figure 13 Examples of Templates Used

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8) **Sharing conclusions**

   a. **What is an ULL**

   b. **What was the most challenging template in the process**

Each table was asked to provide a 2-3 minute debriefing to the rest of the room, synthesizing the outcomes of the discussion by answering the preceding two questions.

6.3 Workshop results

General discussion around the tables was captured on post-it notes posted on the templates. At the end of the workshop, the main outcomes/conclusions of each table were shared in a short debriefing by the participants.

The aim of the workshop was achieved: participants learnt about Urban Living Labs through the introduction presentation as well as through their discussions into the five key elements in Living Labs.

The most challenging template was identified as the last one, management structure for the governance of ULL. (Almost) all groups which completed all of the templates identified this as the most difficult to answer, providing the organizers valuable feedback on what aspects to focus on next, in the methodology handbook, toolkit and/or training materials.

Another challenging template identified by two of the follower cities was template 2: an innovation to experiment with or create. These two cities combined their efforts around one common table and spent most of the workshop discussing the challenges that their NBS are aiming to solve. This exercise provoked the necessary thought process that is needed in order to identify the correct challenge to solve, and to formulate a problem statement around a well-defined challenge.

By analyzing the results of the UNaLab workshop, we identified six main elements that frame a definition of an ULL. These elements are innovations to experiment with, citizens to engage, a mix of methods for engagement of different stakeholders and data collection, management structure for governance of the ULL, infrastructure to support real-life experimentation (e.g. sensor networks), and finally, a mixture of partners with stable and dynamic relationships. Long-term and sustainable engagement as well as co-creating NBSs were also two main key dimensions that were emphasized by city representatives while reflecting on the key defining elements of an ULL.

There were also other aspects that were mentioned by the workshop participants when they were asked to explain and elaborate on the key defining elements of an ULL. These aspects include but are not limited to, testing new solutions, the way to co-construct the city with citizens and local authorities, an innovative governance experience in a real urban context, and a place for implementing new networks.

With respect to the ULL objectives, aspects such as bridging gaps between academia, government and companies, implementing demonstrations before applying a solution to other cities, increasing the visibility of NBSs, increasing citizens' awareness and providing a framework for research work were highlighted by the workshop participants. (See Table 7)

Initial results of the workshop

Table 7 An overview of the workshop results

Cannes	
Definition	**Objective**
Source of data	Provide framework for research work
place to prove participation theories	test ideas with citizens before implementing them in reality
Idea harvesting space	bridging gaps between academia, government and companies
Test area for my product	Generate exchange + discussions
environment when citizens participate in designing solutions	Make demonstrations before apply a solution to other cities
The way to co-construct the city with citizens and local authorities	Cover 360° of challenges of the city
4th helix where solutions are co-created for city	
Stavanger	
Definition	**Objective**
Experimentation	Learning
Physical test site	
Specific projects	
Testing new solutions	
Genova	
Definition	**Objective**
A place where to involve citizens to experiment ideas	Innovation

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A group of persons that collaborate to solve a common problem in the urban context	Replication in other parts of the city or in other communities
A platform to integrate interests of different stakeholders with innovative experience	The goal should be collaboration and relationship between citizens and administrations
A place for implementing new networks	To deploy innovative solutions within co-creation processes
A co-creation experiment with engagement of various stakeholders	Harmonization of different perspectives
ULL is an environment to design, test and evaluate innovative solutions	To solve the urban problems in an effective and sustainable way adopting a user centered design
A shared long-term program of activities	An urban project conveying climate resilience strategies into urban * processes with PPPs
Tampere	
Definition	**Objective**
Possibility / opportunity to test solutions and for R&D	Help to raise awareness and to mobilize people/residents
Not just a project: on-going long-term experiment	Add visibility to NBS in Tampere
Get people involved in creating their future	Innovating Experimenting Knowledge transfer Co-creation
Location + co-creation + governance + R&D/experiment	Improve the livability, sustainability, social-hydrological resilience of the urban area
The concept and actions involving public participation and nature based solutions in a few locations in Tampere	including the public in decision making regarding issues related to their living environment
An innovative governance experience in a real urban context	Looking for innovative solutions through participative methods
	Show-up opportunity to communicate efforts
Prague	
Definition	**Objective**

Experimental territory and management	Experiment to re-evaluate the public spaces of NBSs
Eindhoven	
Definition	**Objective**
Places	Improve
Upgrade of existing projects	Showcase
	Awareness
	Learn
Basaksehir	
Definition	**Objective**
Space for innovations	Raise awareness of the citizens
A real life innovation and experience respect and protect the inhabitants	Create new solutions to identified challenges
ULL should always include users	The new way of scaling of solutions
ULL is a place for different stakeholders to come together	Urban development
A ULL should also focus on long-term scaling of the innovation	To increase well-being of citizens
ULL is a real life environment with real users	To implement NBS to Basaksehir
	A good ecosystem and joint value system model

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7. CONCLUSIONS

7.1 Summary of achievements

In the work in T2.2 the achievement thus far is the development of the framework for ULL, the training program and the workshop that has been carried out. This work forms a basis not only for the practical training program, but as a basis for scientific publications in the area. In addition, the result from this deliverable will support cities in their process of setting up and running an ULL in their respective context.

7.2 Impacts

The impact of this deliverable is the initiation of the learning process among UNaLab front-runner cities and the follower cities in the workshop on ULL framework. In addition, a submission based on workshop results has also been made to a conference focusing on Living Lab research. Hence, if the paper is accepted, the UNaLab project and the results to date will be disseminated among other Living Lab practitioners.

7.3 Other conclusions and lessons learnt

Based on the work that has been accomplished thus far in this task, lessons learned show that the maturity level among cities and Living Lab research related to ULL is rather low. There is a relative dearth of published research in the area and the theory of the ULL concept is somewhat lacking in clarity. Hence, the UNaLab ULL framework has significant potential to contribute both to the research regarding Living Labs and Urban Living Labs as well as the practices of performing ULL activities.

8. ACRONYMS AND TERMS

EASW - European Awareness Scenario Workshop

LL - Living Lab

ULL - Urban Living Lab

NBS - Nature-Based Solution

NPD - New Product Development

NSD - New Service Development

OI2 - Open Innovation 2.0

PADR - Participatory Action Design Research

SDST - Systemic Decision Support Tool

RRI - Responsible Research and Innovation

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