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Living Lab Methodology

Handbook

USER ENGAGEMENT FOR LARGE SCALE PILOTS
IN THE INTERNET OF THINGS

DIGITAL OBJECT IDENTIFIER - 10.5281/zenodo.1146321.

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Contents

Foreword

Methodology, ecosystem, community … during its history the term Living Lab has been given several definitions. What connects these characterizations is the common understanding of the source of inspiration for the whole approach: involvement of people.

The aim of this Living Lab Methodology Handbook is to introduce some research background as well as serve as a practical guidance for researchers and practitioners on Living Lab methodologies, co-creation and user engagement. It also aims to inspire the reader with the lessons learned from thorough research together with real-life cases. The handbook is specifically focusing on the topical area of Internet of Things, as it is of key importance for societies and individuals in today's world. The handbook explains how the Living Lab approach can greatly support the research and innovation activities in that area.

Top experts of Living Lab research and practice have contributed to this handbook by sharing their knowledge on the most recent findings on the topic. The handbook starts with a brief introduction to the context: what is a Living Lab and the context of Living Lab methodologies, including the levels of analysis within Living Lab phenomena: macro, meso and micro. The different phases – exploration, experimentation and evaluation – of the innovation process in Living Lab context are presented in their respective subchapters. The second chapter reveals background insights to the Living Lab metodology specifically in the IoT domain – the FormIT methodology. This section focuses on describing the innovation process based on the progress of the innovation; from a concept to a mature innovation.

The theoretical background for Living Lab methodologies is then concretized with recent studies conducted in Living Labs. The collected case studies presented in the third chapter serve as practical examples of different experiments carried out in the topical domains (wearables, health and ageing, agrifood and smart cities), with four different approaches on how to follow the innovation process and use the varying methods and tools throughout the project.

To best serve the people looking for guidance on the implementation of activities following the Living Lab approach, the fourth chapter links this handbook to a recently developed toolkit, comprising of end-user engagement methods and tools organized according to the phases along the innovation process: exploration, experimentation and evaluation. This section is completed with useful guidance on user selection for innovation activities. Having the aim to widen the context for the whole quadruple helix – private and public sector, academia and people – the best practices and hands-on tools from experienced Living Labs provide concrete advice on the ways to implement experiments which benefit from the Living Lab approach.

Chapter 1

Setting the Context

What is a Living Lab?

"A Living Lab is an orchestrator of open innovation processes focusing on co-creation of innovations in real-world contexts by involving multiple stakeholders with the objective to generate sustainable value for all stakeholders focusing in particular on the end-users".
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Living Labs can be characterized in multiple ways and serve several purposes. They are both practice-driven organisations that facilitate and foster open, collaborative innovation, as well as real-life environments or arenas, where both open innovation and user innovation processes can be studied and experimented with, and where new solutions are developed.

Living Labs operate as intermediaries among citizens, research organisations, companies, cities and regions for joint value co-creation, rapid prototyping or validation to scale up innovation and businesses. These activities take place across many different domains, typically in health and wellbeing, smart cities and circular economy, culture and creativity, energy and mobility.

Despite the multiple different implementations, Living Labs share certain common elements that are central to the approach:

Multi-method approaches: there is no single Living Lab methodology, but all Living Labs combine and customize different user-centred, co-creation methodologies to best fit their purpose.

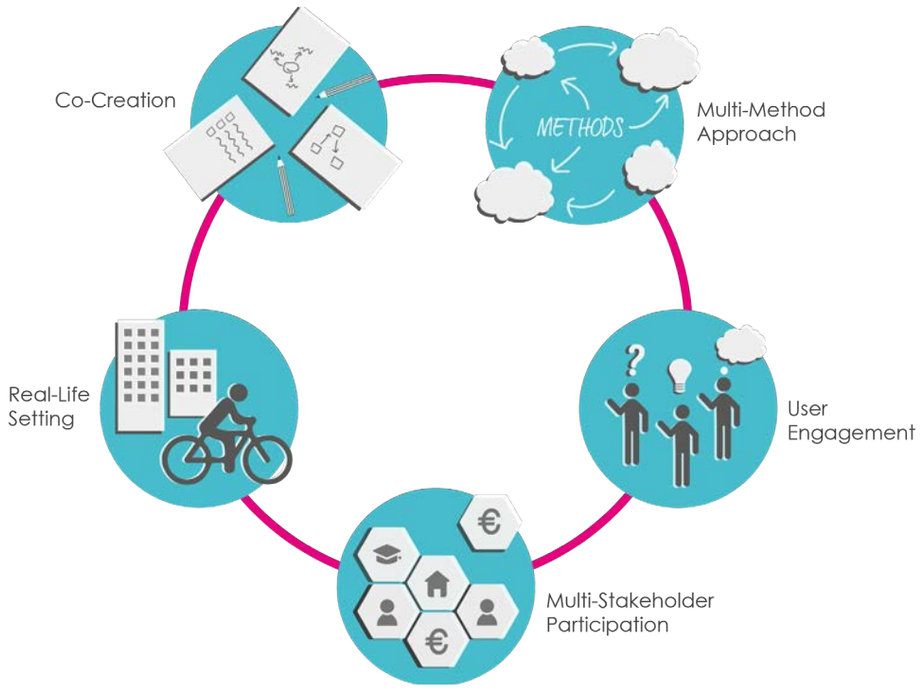

Figure - Common Elements of Living Labs

User engagement: this is rooted already in the origins of Living Labs, the key to success in any activity is to involve the users already at the beginning of the process.

Multi-stakeholder participation: even if the focus is on users, involving all relevant stakeholders is of crucial importance. These include all the quadruple helix actors: representatives of public and private sector, academia and people.

Real-life setting: a very specific characteristic of Living Labs is that the activities take place in real-life settings to gain a thorough overview of the context.

Co-creation: typically, especially in technology projects, activities are designed as top-down experiments, benefiting from users being involved as factors rather than actors. There is an increasing recognition that this needs to change so that users become equal contributors and co-creators rather than subjects of studies. The Living Lab approach strives for mutually valued outcomes that are results of all stakeholders being actively engaged in the process from the very beginning.

Living Lab methodologies

Dimitri Schuurman (imec.livinglabs)

Living Labs are complex multi-stakeholder constellations where a multitude of activities take place. Based on a systematic literature review and on experiences and observations of Living Lab practices, Schuurman (2015) made a distinction between three different levels of analysis within Living Lab phenomena:

- The macro or **organizational level**, where the Living Lab is a set of actors and stakeholders organized to enable and foster innovation, typically in a certain domain or area, often also with a territorial link or focus. These organizations tend to be Public-Private-People partnerships (Leminen, 2013);
- The meso or **project level,** where Living Lab activities take place following a mostly organization-specific methodology in order to foster innovation;
- The micro or **user activity level**, where the various assets and capabilities of the Living Lab organization manifest themselves as separate activities where users and/or stakeholders are involved.

The Living Lab methodology, with the common elements and identified innovation process, thus can be situated at the meso-level, where

As recommended reading, the following booklet gives a good introduction to the history of living lab research and activities "Introducing ENoLL and its living lab community" (www.issuu.com/enoll/docs/enoll-print)

the projects are structured based on it. As presented before, the following principles are core within Living Lab methodologies: active user involvement, real-life experimentation, multi-stakeholder and multi-method approaches. Besides these main principles, another common aspect within Living Lab methodologies relates to the different stages that are followed in an innovation process. From the perspective of the 'innovator', we distinguish between the 'current state' and the 'future state' (Gourville, 2005), where the existing, 'current state of being', the 'as-is' or 'status quo' is opposing 'possible future states' (Alasoini, 2011). This resonates with design thinking, which proposes an iterative approach, based on 'analysis' and 'synthesis', that facilitates experimental learning, and alternates between divergent thinking and convergent thinking (Brown, 2008). Action research is then used as a method to build these methodologies out of concrete cases and projects, carried out within the Living Lab (Dell'Era & Landoni, 2014).

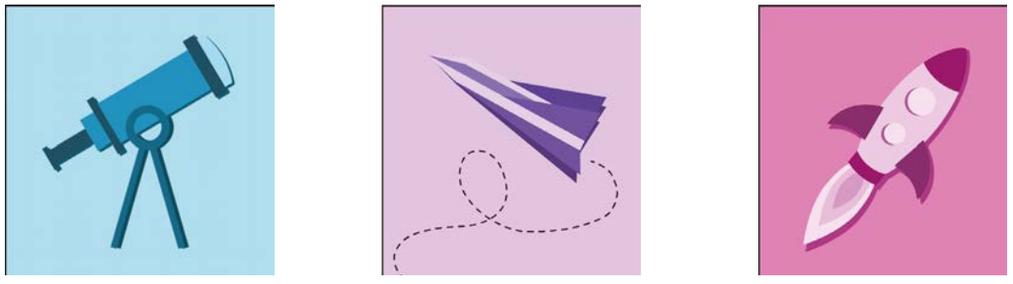

Figure - Phases of Innovation Process

However, to anchor the individual user involvement activities (micro level) with a methodological framework that follows this design reasoning, Schuurman et al. (2013) proposed that Living Lab projects resembled a quasi-experimental approach. This includes a pre-measurement, an intervention and a post-measurement, where the intervention is equalled to the real-life experiment. Following the above reasoning, we can distinguish three main building blocks within Living Lab projects, following the innovation development phases:

Exploration: getting to know the 'current state' and designing possible 'future states'

Experimentation: real-life testing of one or more proposed 'future states'

Evaluation: assessing the impact of the experiment with regards to the 'current state' in order to iterate the 'future state'

In the following chapters, the different stages are represented and the impact of these is described on the nature of the user activities taking place at each stage.

EXPLORATION

The first phase within an innovation project, following the Living Lab approach, can be labelled as 'exploration'. In terms of the New Product Development (NPD) process, this consists of moving from idea towards concept or prototype of the solution. In the language of entrepreneurs, this is the 'problem-solution fit' stage, as you identify the problem and fit your solution as good as possible with the problem. The main goal of this stage is to understand the 'current state'. This means getting an overview of the current habits and practices of users you want to target. A specific focus is put on the current problems they still face, taking into account the specific contexts in which these problems occur. This is done by means of methods and techniques like observation, participation and in-depth interviews.

After understanding the users and their context, one engages in the process of discovering latent needs and wants of the users. Here sensitizing techniques are used to dig into the users' deeper levels of knowledge, uncovering tacit and latent needs and wants. This leads to the definition of opportunities for improvement of the users' 'current state'. These materialize in possible 'future states' that are thought of. This is done by means of brainstorming, ideation and co-creation techniques. All the ideas and options are then materialized into concrete concepts that can be co-designed.

In terms of Open Innovation, this phase can be labelled as involving mainly 'exploration' processes. Exploration is defined as purposive inflows of knowledge or technology, aimed at capturing and benefiting from external sources of knowledge to enhance current technological developments. First, exploration is used to understand the current solutions people use, the current habits they display and the current context in which people use these solutions and have developed these habits. Subsequently, exploration is used to develop and share ideas for solutions to these needs, in order to come to concrete innovation concepts.

This exploration stage also provides you with a certain benchmark of the 'current state'. This is important, as it allows the measurement of

potential impacts and effects of the experimentation stage in order to measure the effects of the innovation. Therefore, this stage also can be considered as the 'pre-measurement' before the intervention, which takes place in the experimentation stage.

EXPERIMENTATION

The second stage within an innovation development process can be labelled as 'experimentation'. In the previous stage a certain solution or 'future state' materialized into a concept, this stage puts it to the test by developing and experimenting with a prototype. Specific for a Living Lab approach is the 'real-life' setting in which the testing takes place. The degree in which 'real-life' can be attained is linked to the maturity of the design. Prototypes can take on many forms, from tangible MVPs (Minimum Viable Products) to intangible services or experience design prototypes, but their main goal is to facilitate testing of the possible 'future state'. In the experimentation stage, the innovation itself is presented as a prototype to the users in the form of a new solution, which potentially triggers new habits and new contexts of use.

The goal of this 'intervention' is to understand user reactions and attitudes to the proposed solutions, and to also capture behaviour, which is made possible by having the testing take place in "as-real-life-as-possible" contexts. Depending on the maturity, the interventions can be labelled as proxy technology assessments, User Experience testing, or actual field trials.

When a prototype is stable enough, the experimentation can take the form of an actual field trial. Depending on the possibilities, this testing can be short to longer term, involve a few to large amounts of users, and can include some specific to all aspects of the solution. In terms of techniques, one should focus on unobtrusive techniques to capture the concrete user behaviour with the solution ('doing') and avoid only relying on what people 'say'.

Summarizing, the experimentation stage puts the designed solution to the test, as much as possible in a real-life context, and allows a decision to be made on whether to head back to the exploration stage to iterate your solution, or whether to proceed to the evaluation stage.

EVALUATION

The third and final stage consists of evaluating the innovation. As the exploration stage provided a benchmark regarding the 'current state' of the end-users, the experimentation stage simulated an envisioned 'future state' by means of an intervention. The evaluation stage enables to generate a 'post-measurement' of the intervention and compare it to the 'pre-measurement' benchmark, illustrating potential impact and added-value created by the innovation.

In terms of Open Innovation processes, this stage is aimed at exploitation. Exploitation entails purposive outflows of knowledge or technology, implying innovation activities to leverage existing technological capabilities outside the boundaries of the organization. Related to the entrepreneurship literature, this stage can also be labelled as the 'product-market'-fit. In the experimentation stage, ideas can be enabled to mature into a tested prototype or design, which can now be mapped into a target market and user population. The goal is to launch and implement the innovation into these target markets, based on a go-to-market strategy.

The focus is on understanding the potential market, which can be done through techniques as market research, user toolkits for customization or conjoint analysis for defining a concrete offering. This also involves preparing a coherent marketing communication and strategy. By combining the pre- and post-measurement of the intervention, it should be possible to quantify your value proposition. A key question at this stage is: what advantages is the 'future state' able to deliver in terms of the 'current state' of your envisioned user population? This also facilitates determining pricing levels, as this is much easier when it is possible to quantify the impact of your solution.

This stage can also consist of the post-launch activities, where actual adoption and usage of the innovation is monitored in order to re-design or add new functionalities according to the needs of existing or new market groups.

For further reading: Schuurman, D. 2015. Bridging the gap between Open and User Innovation?: exploring the value of Living Labs as a means to structure user contribution and manage distributed innovation (Doctoral dissertation, Ghent University), available at https://biblio.ugent.be/publication/5931264/file/5931265.pdf

Chapter 2

Living Lab Methodology in IoT Context

FormIT methodology in IoT context

Anna Ståhlbröst (Botnia Living Lab)

To support a Living Lab approach in IoT innovation projects, it is not only important to go through the different phases of exploration, experimentation and evaluation as mentioned above. It is also important to make progress in these phases to ensure that the level of maturity for the IoT innovation increases. While the former section focused on explaining the different phases in the innovation process related to the actions being taken in the process, this section focuses on describing the innovation process based on the progress of the innovation: from a concept to a mature innovation.

To support the description of this progress, we use the the FormIT methodology as an example (Ståhlbröst, 2008). FormIT has been developed in Botnia Living Lab (BLL) through practical experimentation and experiences from applying it into all digital innovation processes carried out at BLL. Today, FormIT has been applied in more than 100 user engagement processes spanning from early need-finding to real-world tests of market ready innovations.

FormIT is a human-centred approach to develop digital innovations. It aims to facilitate the development of innovative solutions

that are based on a holistic understanding of people's needs, paying due consideration to issues of equity, autonomy, and control in relation to actual use situations. FormIT is grounded in the theoretical streams of Soft Systems Thinking (Checkland, 1981; Checkland and Scholes, 1990), Appreciative Inquiry (Cooperrider and Avital, 2004; Norum, 2001), and NeedFinding (Patnaik and Becker, 1999).

The FormIT process is typically carried out in three phases, each phase consisting of four stages. The process can be seen as a flower where the focus and shape of the design becomes clearer, while the attention of the evaluation broadens from a focus on concepts and usability aspects to a holistic view on the diffusion of the system. In this process four main stages (see figure below) are undertaken within each of the three key phases, as outlined in sub-chapters below, to move IoT systems from ideas that solve societal challenges to solutions that are diffused to the identified customers or user segments (Bergvall-Kåreborn, Ihlström-Eriksson & Ståhlbröst, 2016; Ståhlbröst & Holst, 2016; Ziouvelou et al., 2016).

Figure - FormIT stages (Ståhlbröst & Holst, 2016)

The three main phases are; 1) Concept design; 2) Prototype design, and 3) Innovation design. In each of these phases, four stages are carried out: 1) Explore, 2) Co-create, 3) Implement and 4) Evaluate, which are repeated in iterative processes. Besides these three phases, one additional phase is included: the planning. It stands for planning the project as a whole and here it is important to gain as much information as possible about the underlying circumstances for the project: its aim and scope; different perspective on the project; and constraints and boundaries that need to be accepted.

Often, the prototype phase is iterated several times until the prototype is stable enough to be implemented on a broad scale in a real-world context (Ståhlbröst & Bergvall-Kåreborn, 2008; Ståhlbröst, 2008). In the following when referring to IoT, we refer to the services that are being developed based on IoT data.

IoT concept phase

In the first phase, concept design, the focus is on exploring and conceptualising the basic needs that different stakeholders have in relation to the imagined IoT solution, e.g. IoT-data based service. These are the needs that motivate them to acquire and use a particular solution. Following the language of Soft Systems Methodology, these needs are part of the "Weltanschauung" (worldview) that makes the solution meaningful to use, and they may vary and take different forms depending on stakeholder, context and situation. The challenge in the first step, explore, is thus to identify the key needs in relation to IoT innovations, and the different expressions they may take. This is done by obtaining a rich picture of different stakeholders and user groups, their behaviour, attitudes and values by using storytelling techniques and open data collection methods.

FormIT has been developed to focus on encouraging users to tell rich stories with the purpose of identifying their needs, or underlying rationale, relevant in a particular situation (Ståhlbröst, 2008; Ståhlbröst, 2012). Focusing on telling stories instead of answering specific questions about needs and requirements has encouraged users to talk about, and discuss, their situation and dreams independent of any technical solution or artefact. Hence, they could elevate their perspective from what might be technically feasible to what they consider as desirable and meaningful in the situation. In these stories, users talk about their needs in relation to particular situations and usually independent of a specific solution or artefact. In this way, it is possible to find users' underlying rationale related to their needs of a possible final solution.

When the data has been collected, it needs to be analysed and categorised to give a deep understanding of stakeholders' needs and values, here, e.g. different personas can be developed to give life to the constructed needs and values. Value mapping techniques can also be used. When an understanding of the stakeholders' needs and values is reached, the creation of concepts begins. The aim of the co-create step is to develop several conceptual ideas that answer to the needs and values that have been represented in e.g. the personas. The concepts need to be detailed enough for the users to understand the added value and the objective

of the IoT concept. Important to note in this phase is that the concept should not be detailed and focusing on functions of the IoT system, it should rather describe an idea that answers to the elicited needs and values. To support the creation phase, co-creative methods such as brainstorming, body storming, word concept association can be used.

When several concepts have been co-created, the focus shifts again. In the implementation phase the conceptual IoT idea is put into its real context, which in this phase can be in a scenario or a user story describing the concept. Finally, the concept is evaluated with the relevant stakeholders focusing on the attractiveness of the concept in relation to the needs, values and KPIs that were identified. This evaluation can be supported by methods such as concept evaluation, dotmocracy (voting on ideas with dots) or thinking hats having a formative approach.

IoT service prototype phase

In the prototype phase, the process focuses on exploring opportunities and stakeholders' needs in the IoT idea concept as well as Key Performance Indicators for the IoT service. In this phase, the known needs, as well as identified values and KPIs, form the basis for the vision of the IoT prototype that takes form in phase two. That is, when using an IoT based service, what needs are then important for the users. This can be expressed in e.g. requirements, functions or visions. As in the first iteration, this is done through a variety of data-gathering methods, such as focus groups, co-design, cultural probes, interviews and observations and of course the results from the evaluation of the concepts in the concept phase. The challenge in this second phase is to separate between needs of the service and needs in the service. Usually an idea of the future solution has started to take form, hence the concepts will be further developed in the form of storyboards, mock-ups and/or software prototypes of the innovation.

Broadly speaking, there are two types of prototypes; low-fidelity and high-fidelity. Low-fidelity prototypes are concerned with developing models that capture what the product will do and how it will behave, while the latter is concerned with details of design, such as screens and menu structures, icons and graphics. This can be presented in different forms, some want to develop a software prototype, while others prefer easier models. Dependent on where in the development process the project is, the focus for this development extends from concepts to final design of the service. One way of doing this is to keep the designed concept, with key needs related to it, visible for the users during the data collection activities, so it is possible to relate to these during the discussions. This phase is usually iterated several times as the prototype becomes more and more mature.

When the data collection no longer generates new insights and findings the focus again shifts to the create step. In the second iteration, the creation of the IoT concept is broadened to include basic functions, work flows, and interfaces. In this phase, the creation step can be supported by using methods such as task analysis or card sorting. Here it is important that the prototype is detailed enough for the users to understand and anticipate how the final solution will work. In the early stages of the prototype, implementation (manifestation) of the idea can be made in user journey maps, user flows or service blueprints. In the latter stages, the prototype can be implemented in mock-ups and finally in being a functioning prototype that can be tested in controlled environments such as a lab. In the later stages, the evaluation focus is on usability and bug testing, while in the earlier stages, the focus is usually on usefulness of the prototype. To support this process, methods such as usability testing, A/B testing, guerrilla testing, eye tracking and/or blink testing can be used.

IoT innovation phase

As the prototype becomes more mature, the innovation phase begins. In this phase, the exploration step consists of the input from the previous evaluation focusing on the combination of end-users needs of as well as in the innovation. In addition, it is vital to understand users expected experience from using the IoT innovation. In the creation step, the focus is to design the business model for the innovation and fine-tuning the design of it. Small changes and adjustments in relation to requirements are quite common, especially in relation to service requirements, as the system develops and users' understanding of structure, content, workflow and interface deepens. Based on these changes, changes in the design of the innovation also takes place, as well as general development work to finalise the IoT innovation.

When the creation of the innovation is finalised, it should be implemented in a real-world context where the end-users can interact with it in their everyday context and in combination with their other systems, activities and contexts. To support the implementation stage, it is important to sign agreements of matters such as responsibilities, usage and privacy. Other issues important to consider is the context in which the project should take place. These issues are related to the contexts in which the IoT service being developed is aimed to contribute to. Users' response to an innovation can be influenced by how well it merges into their context and their activities. Even things that are not directly linked to the innovation can influence the users' experiences of using the product. Hence, to identify and consider aspects in the expected context, and how these might influence the forthcoming evaluation results, becomes important. At this stage, it is important to define:

- what in the context might have influence on the IoT innovation as well as;
- what, in the context, the IoT innovation can influence. This includes privacy issues, movement patterns, feelings, experience.

After these underlying circumstances for the real-world implementation have been determined and agreed upon, the issues that need to be discussed become more focused in character. The aim now is to get information about issues related to the boundaries for the evaluation such as:

- Identifying the target group for the innovation and the evaluation.

- Setting the time-frames of the evaluation, aiming at identifying critical milestones. This means, for example, that it is not appropriate to do a test of a typical seasonal service in an inappropriate season, such as a service warning about slippery roads during summer. This might seem obvious, but it has shown to be easy to forget, hence causing the project to become a bit inactive, waiting for the right conditions to emerge. In addition, the test is often one of the last activities in a project; thus, any earlier delays in the project become obvious. Thus, the timing of the test needs to be considered throughout the project.
- Discussing if there are any power relations that are of importance to consider and how that can have influence on the evaluation.

When this is done, the last evaluation phase takes place and now the evaluation is focused on user experience of the finished service. User experience goals can be both positive and negative, for example enjoyable or frustrating. They are primarily subjective qualities and concern how a system feels to a user. They differ from more objective usability goals in that they are concerned with how users experience an interactive service from their perspective, rather than assessing how useful or productive a system is from its own perspective.

Performing tests of IoT solutions in real world contexts, where the test situation cannot so easily be supervised and observed, high demands are put on the design of the test to create as authentic usage situation as possible during the period of test. The creation of an authentic usage situation requires deep understanding of the users' every day situation as well as their needs relevant in that situation. Hence, users' needs are important to incorporate in the design of the test to increase the probability that users actually use the IoT innovation during the test period. The creation of actual usage situations also means creating stimuli actions to encourage users to change their frame of reference to include a new behaviour, i.e. a new usage situation. This aspect is central during evaluations in a real-life context since users have a natural inertia to change their behaviour. Due to that, the truth about users' probability to buy, or use, the innovation when it is introduced into the market, is impossible to gain during a short period of test. Dealing with innovation means to deal with uncertainty, hence it is vital to remember that it sometimes can take years for an innovation to have an actual impact on users' behaviour or attitudes. The main thing when dealing with innovations is to have a process supportive of learning from failures, as well as from successes. An additional issue that can support these actions is to learn from non-users.

For further reading, have a look at the following publications:

- Ståhlbröst, A., & Holst, M. 2017. Reflecting on Actions in Living Lab Research. Technology Innovation Management Review, 7(2): 27-34.
- Bergvall-Kåreborn, B., Ihlström Eriksson, C., & Ståhlbröst, A. 2015. Places and Spaces within Living Labs. Technology Innovation Management Review, 5(12): 37-47.

Chapter 3

Case Studies

Introduction to the case studies

Four case studies from European Network of Living Labs (ENoLL) members have been selected to give concrete examples on Living Lab approaches applied in practice.

The four cases each represent differing approaches towards Living Lab methodologies in the context of exploration, experimentation and evaluation, identified according to their innovation process characteristics (linear versus iterative) and usage of tools (standardized versus customized).

Leminen and Westerlund (2016) categorize these four approaches through their visualization in the format of a matrix using the terms: linearizer, iterator, tailor and mass customizer.

Within this matrix, the linearizers identify their innovation processes as linear: following a structured and pre-determined phase-by-phase method. They also use standardized and pre-defined sets of tools. Similarly, iterators are using standardized tools, but rather than following a linear process, they are performing in an iterative fashion: adapting the process based on the input from previous activities. Unlike linearizers and iterators, mass-customizers and tailors do not utilize standardized sets of tools. Mass-customizers instead customize these tools, while still following a linear process from experimentation to evaluation. Tailors, on the other hand, use customized tools and follow an iterative, non-linear process.

The following four case studies represent these four approaches to Living Lab methodologies, all selected from different domains typical for Living Lab activities:

1. Linearizer – wearables, case m-RESIST (imec.livinglabs)
2. Iterator – health and ageing, case "Care(e)rs Rally" (Autonom'Lab)
3. Mass-customizer – agrifood, case FRAC-TALS (PA4ALL)
4. Tailor – smart cities, case SmartLab (Guadalinfo)

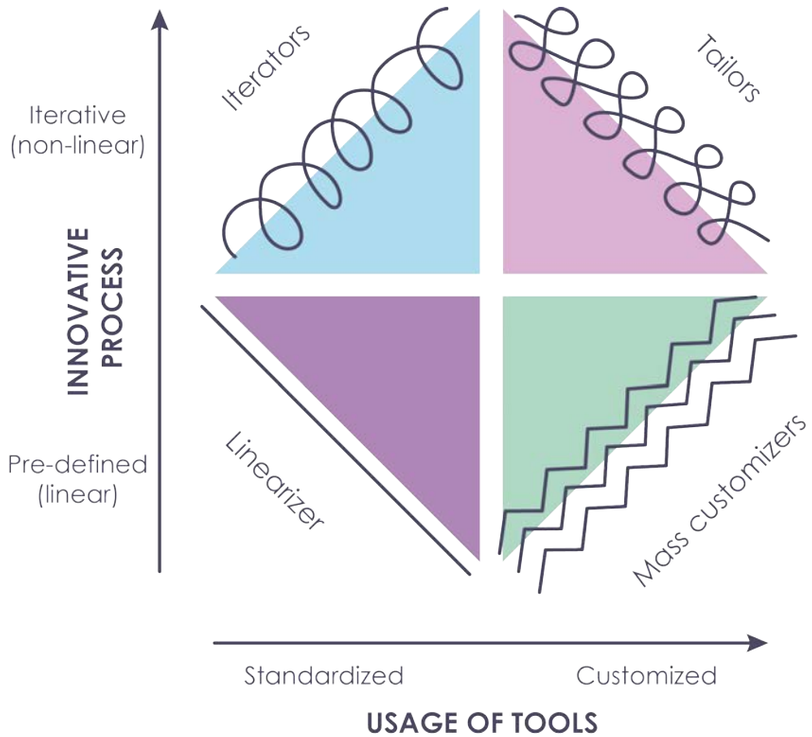

Figure - Matrix on four approaches to innovation process and usage of tools;
Note: Adapted from Leminen & Westerlund (2016)

Further reading about the matrix on Leminen, S. & Westerlund, M. 2016. Categorization of Innovation Tools in Living Labs. Technology Innovation Management Review, 7(1): 15–25. www.timreview.ca/article/1046

WEARABLES

CASE M-RESIST

IMEC.LIVINGLABS

Project background

The objective of the m-RESIST project (www.mresist.eu) is to help patients that have resistant schizophrenia, which means that they do not react to drugs given for treatment. Consequently, they must be helped in other ways, and one way of helping them is by doing behavioral therapy and trying help them through wearable technologies. The wearable technology used in the m-RESIST project senses data and sends it to the smartphones of the patients, which are connected to predictive models that try to foresee whether they are about to have a schizophrenic fit. If the model sees potential dangers, communications begin with the patients, caregivers and friends and family, as well as the psychiatrists treating the patient. The reason for using wearable technologies as opposed to other types of devices is that wearables pose a very unobtrusive way to capture biometric data. Using headsets or other devices on a patient may produce more accurate data but is of no use when nobody wants to wear these devices on a daily basis. A wearable, in this case a wristband, produces better results because people are willing to wear their devices for longer periods of time.

End-user engagement

Besides the patients as end-users in our project, we are also closely involving their caretakers and those treating them, i.e. psychiatrists and psychologists. Additionally, a very important component in treating patients is the social network of the patient, particularly their friends and family. All these stakeholders have been included throughout our entire design trajectory. It is important because without the involvement of end-users you may end up with building a product that nobody wants. At the core of what we do is guiding the design process through iteratively building a product that is as desirable as possible, because we want it to have as high a potential for uptake as possible.

Involvement of other stakeholders

Academia

One of the aspects of importance in involving researchers lies with design science research. Design science is about building research while you design; the researcher is giving something back so that others can learn from what they have done. At the core of this discipline is behavioral science and the kernel theory, the behavioral theory that drives the design of the application. This means, in our case, involving the psychologists and the psychiatrists in contributing with their domain-specific knowledge, giving a lot of value to the project.

Public sector

Working together with publicly owned hospitals opened the doors to our panel of end users, but the hospitals are also often academic hospitals so they are to some degree playing the academic role as well. Furthermore, they are the key to accessing patient records, and the importance in involving the public sector often lies with access to information. In a follow-up project involving public organizations would be important as they can play an important role in the business model around the final product. For example, financial aids or insurances might be able to offer lower fees if the patient is utilizing the technology, or money can be reimbursed for certain treatments etc. In the business model perspective, involving the public actors is especially important.

Private sector

We involved the private sector by using commercially available technologies as well as by working together with private technology companies. When working together with the private sector, it is important to ensure that the goals of the business are well aligned with the goals of the approach of the project. Although it sounds very simple, this is something that is often missed across projects. When working with commercially available technologies, on the other hand, it is important to choose the infrastructure that is as open as possible, to be able to work across different types of devices. The companies offering wearable devices are often attempting to lock in their customer to their own ecosystem, yet it is very important when putting something to the market, that is for people to use, that they are able to use it across many different types of hardware. Compatibility across the devices is something that is difficult to achieve, and of course privacy issues concerning the access to data are very important as well. To quote Neelie Kroes (European Commissioner for the Digital Agenda in 2010-2014), “data is the new oil”

EXPLORATION

For us, the user researcher is at the core of the Living Lab process, what they do is capture the end user behavior. It is important for this research to be ongoing, prolonged and longitudinal, and one of the ways to capture data is through wearables. This helps also in prototyping, as wearables make it possible to capture end user behavior in such a way that prototypes can be improved based on the feedback. Wearables can be used for example in detecting stress levels, when using a particular product or application. This allows for cross-validating feedback collected, for example for affective computing, where different signals are combined to form insights - for example, combining biosignals like the sweat on your skin, to correlate with what you were doing on your device at the time.

EXPERIMENTATION

When building our prototypes, we aim to build the prototypes as cheap as possible. The idea is not to engage a lot of effort into building something that could be the wrong thing in the end, but building very cheap and lo-fi prototypes as quickly as possible. Because if they are cheap to make, they are also cheap to destroy and remake if you find out that you are not doing the right thing. Also, testing your prototypes in a real-life setting is important because if you are testing something that is happening on the street, you must also test this on the street, and not in a lab.

In the m-RESIST project we also provided the Living Lab methodology and devised a protocol for conducting the workshops, the Living Lab co-design sessions, in different countries. Due to restrictions regarding resources, cultural or linguistic capabilities, it was not possible to conduct all of the co-design processes indi-

vidually, therefore local partners have been guided in running the workshops themselves. These sessions included creating scenarios for the use of the wearables, together with the technicians involved, creating wireframes and studying how people are reacting to these wireframes. Similarly, mock-ups were created to study the reactions of the participants. After the mock-ups, the building of prototypes has begun and we are currently testing our prototypes with the end users.

PROJECT OUTCOME - EVALUATION & FOLLOW-UP

The project is about learning things, about building prototypes - because the main reason for building a prototype is to learn what works and what doesn't. The project is at the moment ongoing, but in the end the outcome of the project will add to the knowledge on wearables and the different aspects to be taken into account when building such systems. The commercial actors in the project can also put this data into building a model of schizophrenia, for example a machine learning model, or building their own tools for gathering data or feeding this data online. In the end, many things are given back to the society and the economy through the project.

Throughout this project, we have also learnt to recognize the fast pace of the wearable technologies, as the pieces or hardware we were planning to work with originally had already become obsolete by the time that work on the project started.

Methodologies used in project

The Living Lab methodologies used in the project include:

- Design Thinking
- Interviews
- User persona
- How might we / other workshops create first ideas or understand the problem
- Brainstorming / other workshop to create ideas for solutions
- Usability workshop / other workshop to try out, test, and improve, validate, the solution
- Feedback workshop /other workshop to gather feedback from users
- Prototyping
- Minimum Viable Product (MVP)
- Community Building
- Scrum / Sprint

Our process is based on the SCRUM methodology (www.scrumguides.org), every 2 or 3 weeks we are reviewing the backlog and launching a Sprint for meeting the elements in the backlog (www.scrumguides.org/scrum-guide.html#events-sprint). We also work with Minimum Viable Products (MVPs); after delivering an MVP we already begin planning on the next MVP together with the stakeholders.

Category: linearizer

From the four approaches provided, the m-RESIST project fits best in the category of linearizers. Although some standardized tools were used throughout the project (such as personas, MVPs) and iterative processes were followed (such as SCRUM), we iterate on the consequential phases as a linearizer. SCRUM is an iterative and agile approach to management that can be used in both development work as well as design work - going through the different sequential stages as you would do as a linearizer, although the process is very iterative in its nature.

Further information about the case:

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HEALTH AND AGEING

CASE CARE(E)RS RALLY

AUTONOM'LAB

Project background

The "Care(e)rs Rally" is one of the solutions arisen from a collective study "Career path for home care professionals", which aims at improving the quality of home services delivered to elderly or disabled people.

The overall objective of the Care(e)rs Rally project is to allow people interested in these jobs to discover the realities of these professions through role-playing workshops and discussions with experienced professionals (see an introductory video here: www.vimeo.com/195953219). To reach this solution, detailed analysis was carried out - during the collaborative study - to investigate the home workers' professional pathway, as they play a major role in keeping the independence of older people at home. To make these jobs more attractive, a "state of the art" was established to determine the actual working conditions of a home care professional, and bottlenecks were identified on the pathway for which a solution was to be found. This collaborative experience was realized with and by stakeholders from the whole regional ecosystem.

One of the solutions experimented was the organisation of a rally, because often people who apply for these jobs do not know the reality and their difficulties. The employers use a lot of time to find the adapted applicants and the employees risk to spend time in searching for a job that is not adapted to their professional path. Thus, during the first edition of the rally, in one month, 222 people had the opportunity for example to meet employers, to try technical aids and to have an exchange about these careers with workers in the field.

End-user involvement

For us as a Living Lab, the very essence is to work on our projects with the users. Therefore, considering the choice of this theme for our collaborative study, it was obvious for us to associate all actors of Autonom'Lab Living Lab interested in the question to clarify the whys and wherefores of the issues experienced by the caregivers.

The project "career path for home care professionals" consists of different phases: framing and follow-up of the project through the steering committee / diagnostic / reporting of results for stakeholders / co-design of solutions / implementation / evaluation of solutions. The users were involved differently in each phase.

End-users in this context consists of:

- The final beneficiaries, who were present through a representative of the Collective of Association on Health (CISS Limousin) at all the steering committees of the study as well as a mobilization of their members during the different stages of the project and conducting some rally's workshops.
- Intermediate beneficiaries, i.e. home care professionals. It is not always easy to get these stakeholders involved, because of the tight resources in this sector. Employers sometimes ask for delegates to represent their common interests. When it was possible to involve home care professionals in the process, this option was often retained: integrating them into the steering committee and in the different stages of the project through their employers and sector managers but also by the training organizations that have special contact with them (during training time) and have thus a different point of view than the employers. In the diagnostic phase, home helpers, nursing assistants, an occupational therapist and representatives of the nurses, physiotherapists and physicians were also involved. Some employers accepted to involve home care professionals during the co-design phases and during the rally's workshop.

Involvement of other stakeholders

Academia

The academic institutions (specialized school, specialized training organization) were involved because they have different kind of contact with home care professionals, have a different vision of their difficulties and their needs. Furthermore, they are concerned with the improvement of jobseekers' interest towards this sector, as they provide them training.

Public sector

The public sector was represented by the different institutions related to this sector (Departmental council, Health and social training regional department, State representative). Their involvement allows taking into account their constraints and the sectors' constraints and relying on policy levers.

Private entities

Employers in the sector as well as training organizations are widely involved in the process to share their difficulties and good practices. They are also very important in the co-design phase to imagine adaptive solutions to their reality and constraints.

EXPLORATION

The first phase of the project consisted of a diagnostic phase to identify areas of tension on the career path of these professionals. In this phase, the different categories of users were associated in the following way:

- 10 home helpers were interviewed and 2 of them observed in a professional situation
- 20 in collective maintenance (2 separate groups),
- 5 medical/psychological assistants or caregivers were met individually,
- An inter-professional group of the home, with representatives of the nurses' committees (regional and departmental), physiotherapists (regional), doctors (regional) and an occupational therapist. This group made it possible to work on the definition of the profession of home help, the tensions and difficulties they perceived or encountered in their interrelation with these professionals and more widely this sector.
- A "beneficiary" group with 4 elderly people with disabilities or caregivers to identify the role they perceived from home help, the qualities they expected from their home help and the difficulties they face.

During the reporting of results for stakeholders and co-design of the study, at least five home assistants as well as representatives of the nurses, physiotherapists and physicians, as well as employers, training organizations and representatives of the final beneficiaries were

present and participated in the co-creation of the solutions. A very precise casting had been defined to have at least one representative of the home assistants and one representative of the beneficiaries in each group. In the co-design groups, participants worked in five groups on three life scenarios of three home support professionals, based on interviews with field professionals. Field professionals emphasized the value of finding themselves in the proposed life scenarios and finding out how their opinions had been listened to.

EXPERIMENTATION

Among the innovative solutions emerging from the study, one was a "Care(e)rs Rally" of the professions of the home help. The aim of this action was to make the people interested in this profession and to be aware of the different faces of it, to help them to choose whether or not to pursue this career path.

This project was co-built with the sector's stakeholders through the organization of three meetings bringing together actors of guidance, employment, integration, training, employers in the sector "Help at home" but also their partners and always a representative of the Collective of Association on Health.

The co-construction of this project together with all the stakeholders has allowed to construct a format that is most adapted to the final public. The rally supports were also presented directly to two assistants at home and two people looking for work to ensure that the vocabulary and the materials presented to the public are appropriate. Finally, the prescribers (public orientation and employment services, insertion structures, specialized school) were also available to accompany the public in the experimentation of this rally.

The rally was based on seven topics (defined by the partners), that the participants had to validate with the aim to receive their certificate "Discover the job of Home help". These seven topics were: employers, job reality, working conditions, beneficiaries, training, other professionals in the sector and professional evolution.

The rally was tested for the first time in Haute-Vienne during one month in 2016. It reached 220 people, who participated on average in 4.5 actions among the 42 actions proposed throughout the month at the rally. Among the 42 workshops, there were some in-situ or simulation workshops, exchange with professionals or with beneficiaries to understand the reality of the job, as well as serious game, game or quiz.

In order to ensure that the participants' expectations were appropriate to the objectives of the rally at the beginning, a period of interpersonal and intrapersonal reflection was proposed during the launch conference at which participants were invited after the presentation of the action, to indicate their expectations. Finally, at the closing conference, the participants' feedback was surveyed: through interpersonal and intrapersonal time again with post-it notes to know if their expectations had been met and if so, what were the main points they had on the rally, and a questionnaire of satisfaction was handed to them. An assessment meeting was also organized with the members of the Steering Committee to be able to trace the remarks of the participants.

PROJECT OUTCOME & EVALUATION

From the study "Career path for home care professionals ": five tracks came out of which one was tested: the "Care(e)rs Rally" of the homecare trades.

The results of this action are very encouraging with a very good participation of the public: 220 people, and a great mobilization of the partners: 44 partners including 27 mobilized to propose a total of 42 actions throughout the month that the rally lasted.

Following the experimentation phase, during the nine-month evaluation phase of the impact of the action, the users' opinion is again being requested through an ongoing survey to find out what they have become and what improvements they would like to see implemented for a next edition of the rally.

In terms of impact, the evaluation of the activities is in progress. According to the results received, the participants were very satisfied at the end of the rally. Employers weren't totally satisfied because of the low quality of applications received. Currently the rate of training as well as penetration in the employment of participants of the rally is being surveyed. A kit developing the methodology to adapt the rally to other territories was created. Three territories of the region have shown their interest and one of them has already plans to set it up.

Methodologies used in project

A wide range of different methodologies were used during the course of the study:

- Living Lab methodologies
- Design thinking
- Interviews
- Visual interviews / collage
- Observation / shadowing
- Photo Journal / User diary / Guided tour / Empathy prototyping
- User persona
- How might we / other workshop create first ideas or understand the problem
- Brainstorming / other workshop to create ideas for solutions
- Service design workshop / other workshop to develop the solution together
- Usability workshop / other workshop to try out, test, and improve, validate, the solution
- Feedback workshop /other workshop to gather feedback from users
- Social media
- Video support/media support by the final users

The final and intermediate users as well as the other stakeholders were involved at each part of this project to ensure the creation of well-adapted solutions. Interviews were carried out to identify the vision of the difficulties in the professional careers of home helpers and their knowledge about the good practices in their territory. During the first phase, we took benefit of an international event the CIMA, where we invited people to add their suggestions on post-it notes and to prioritize the most important difficulties and the tensions in the professional careers (visual interviews / collage).

During the co-creation phase, associating representatives of all stakeholders, we created three personas representing home help. This method allows people to know the daily life of home help and be more realistic in the conception of innovative solutions. During the workshops the participants were invited to suggest the topics on the rally and to create a framework for the quiz diffused during the rally. For that we used some brainstorming and world café methods. The website of the rally was tested in advance by home help professionals and people who were directly the target of the rally to ensure that it was adapted. In addition, we can say that this first rally was a test to experiment with the concept of holding such a rally.

In order to involve the IoT sector, we organized - in partnership with a digital cluster (Elopsys) and a digital network (Aliptic) - a workshop on the theme "Digital and Care" during which we presented some IoT experiences in the home help sector. After these presentations we organized a large network between members of these two sectors to identify innovative solutions. Two innovations were drafted but didn't find any financing to be developed further. In addition, a students' challenge was organised with 17 students from 5 different training programmes. They had to answer to two challenges: how to improve working conditions with the help of IoT? How to make these jobs more attractive with IoT? Four groups worked on these questions and provided four innovative solutions that were presented on a Pecha Kucha evening.

To communicate about the rally, we animated a Facebook page and our Twitter to share information about the rally. Nine different stakeholders of the rally were interviewed during the closing conference. These interviews are available on Vimeo, and a teaser joining these nine interviews was made: https://vimeo.com/195953219

Category: iterator

Our method relies on tools that we already experimented in other collective study. This method is split in different phases:

- Definition of a Steering group to choose the subject to explore and follow the different steps of the project
- Collective study in order to share the vision of all the stakeholders on the subject
- Highlight the most important difficulties and good practices
- Organization of many workshops to co-design innovative solutions.
- Define priorities to develop a project
- Set up workshops to prototype the innovative solutions along with all the stakeholders concerned by the subject
- Experimentation of the solution
- Impact and conformity assessment of the solution

For each step of our methodology we organized co-design sessions with many stakeholders in order to validate results, topics and thematic and try to adapt the process if needed.

Further information about the case:

Living Lab: **Autonom'lab**

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AGRIFOOD

CASE FRACTALS

PA4ALL

Project background

The main purpose of the FRACTALS project (www.fractals-fp7.com) was to support its start-ups and SMEs across Europe and help them in better market penetration of their innovative ICT for agrifood solutions based on FIWARE technology. The main results of the project included:

- 43 newly developed applications with high market potential by innovative ICT SMEs and startups coming from 12 different countries, nurtured with FRACTALS support
- Technical training plan and material to ensure correct transfer of knowledge obtained by tech team in the previous projects
- Established FRACTALS Validation community through mass screening process on farmers and other stakeholders. Validation community gathers 675 lead users that are working closely with FRACTALS beneficiaries on testing and validation of their solution in open innovation environment.
- 20 sub-projects performed real-life testing and validation through PA4ALL, a Living Lab which was enhanced geographically with a pool of users outside Serbia, and with users that are not so tech adept for not to skew the results.

End-user engagement

End-user engagement was highlighted in the project with following objectives:

- to gather a critical mass of end-users (farmers and other actors in the value chain, i.e. agronomists), able to interact with ICT companies (solution developers) and provide feedback on their applications;
- to provide a collaboration framework on which end-users and developers can work together;
- to test and validate the applications developed by SMEs and Web Entrepreneurs, through the FRACTALS User Community, by providing the ground for open interaction, without pre-defined roles between developers and end-users;
- to support beneficiaries in bringing their applications closer to the market, by gaining insights on what the market really needs.

Involvement of other stakeholders

Academia

PA4ALL invited scientist in co-creation process with two aims: first, to bridge the gap between scientist and lab-based research and day-to-day farming practice in informal and natural manner, and to enhance knowledge and idea sharing between these two groups. The second objective was to inspire scientists to work on new solutions based on input generated by farmers. In this way, the scientific discoveries will have both impact on world-class research as well as on everyday life and professional achievements of farmers.

Public sector

PA4ALL is a unit hosted and supported by the BioSense Institute, aiming to introduce the Open Innovation concept to the socio-economic system of Vojvodina region. Therefore, we have involved the Government of Autonomous Province of Vojvodina due to their strategical decision-making authority. The Government brought its network of agricultural extension services (since they are state-owned) and many other relevant experts. Moreover, their position brought credibility to the Living Lab, so that farmers (who are reluctant in approaching new initiatives) were encouraged to join the initiative. On the other hand, the government received valuable feedback on their plans for further development of agricultural and ICT policies, and insights into day-to-day needs and obstacles that farmers are faced with.

Private sector

Private companies were involved in two main activities:

- co-designing of technical solutions between ICT companies and agricultural producers
- exploration of emerging issues on the market (the process of development of ideas dedicated to agriculture and food security, validated by a considerable group of people)

EXPLORATION

At the beginning of FRACTALS project, the focus was in connecting the ICT community with end-users (farmers). Inspired by the speed-dating methodology, PA4ALL Living Lab introduced an innovative approach in the establishment of the collaboration framework – the speed dating sessions – and facilitated numerous B2B meetings where people from both the ICT and agri-food industry presented their problems, ideas, and discussed about the same topics from different perspectives. Some of the broken myths which were identified include: Farmers don't know how to use ICTs (reality: ICT companies are first developing technologies and then searching for problems to solve); Farmers don't want to invest money in ICT (reality: Farmers are reluctant to share information).

EXPERIMENTATION

In order to facilitate testing of developed solutions and gathering feedback from end-users, ICT companies were matched with end-users based on their reported needs in terms of farming practice, type of crops/animals, services, etc. After the matching, companies were put in contact with the end users and several meetings were organized where testing methodologies were discussed. During the next phase, the technical solutions were set on farmers' land and they started to test them in real-life conditions.

EVALUATION

After the testing period of 1-6 months on average, two questionnaires were distributed, an anonymous one to the companies and one to the end-users. The questionnaire for compa-

nies had the aim of evaluating the usability of information provided by the end-user to SMEs in terms of functionality and future improvements of the provided solutions, as well as companies' satisfaction with the provided services, while the questionnaire for end-users had the goal to evaluate the marketability, efficiency, and user satisfaction of the solutions.

More than 30 end-users were actively involved in testing and validation of solutions developed in FRACTALS sub-projects. The final solutions were co-evaluated together with the end-users, half of whom rated the efficiency of their solution as "extremely efficient". The second half rated their solution as "efficient" in terms of time and resource, and only 2 out of the 30 found their solution as neither efficient or inefficient.

Project outcome

The results of the specific approach of FRACTALS project can be summarized as follows:

- A broad-based, robust technological capability to invigorate ICT SMEs value creation in agriculture – FRACTALS has supported and nourished the creation of 43 innovative market ready FIWARE-based applications which address concrete problems and needs in agriculture;
- Strengthening the systemic dialogue and cooperation between the ICT industry and the agricultural sector, FRACTALS has initiated and established new models of communication and collaboration by involving end-users in the testing/validation assignment through a Living Lab environment but also by organizing events dedicated to demo days and matchmaking between these two industries.

Nevertheless, this was not the end of our collaboration journey. The end-users have been involved in the co-creation process with industrial partners, namely ICT companies (both start-ups as well as already established and successful ones) that are developing solutions for smart agriculture through series of interactive workshops organized all over the Europe. The main outcome of the project are the fruitful collaborations between different stakeholders, establishing numerous joint project initiatives that are purpose-oriented with broad international coverage.

In the course of the H2020 KATANA project, a crowdfunding campaign is organized, where the end-users of the ICT solutions have an opportunity to test, validate and provide their opinion on business ideas that cross-country and cross-sectoral teams established during an intensive bootcamp weekend.

End-users will also be involved in activities of a BioSense demonstration farm, where state-of-the-art technology solutions will be presented and used in a novel way, gathering a broad range of stakeholders from academic institutions, ICT providers, commercial companies from other sectors and many others. BioSense and PA4ALL strongly believe that the most important links in advanced ICT for agriculture are farmers providing their needs as a relevant and solid foundation for further R&D work within commercial companies and academic institutions.

Methodologies used in project

Two main categories of methodologies were used in the project:

- Brainstorming / other workshop to create ideas for solutions
- Service design workshop / other workshop to develop the solution together

The target was to modify and adjust several methodologies to provide the best outcome. Therefore, in conducted speed-dating sessions, brainstorming was encouraged between farmers and "geeks" on topics related to needs of agriculture. After identification of the needs/challenges, they worked together on the technical solution that would bring benefit to both sides.

Category: mass-customizer

The project was identified as mass-customizer in the approach to the innovation process. Although the linear innovation process was followed, the attempt was to adopt, modify or even invent new effective tools that would have significant impact on the topic.

Further information about the case:

Living Lab: **PA4ALL**

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SMART CITIES

CASE SMARTLAB

GUADALINFO

Project background

Two main conceptions have made the Guadalinfo SmartLab appear (see the introductory video at www.youtube.com/watch?v=vHT29gV9_cE). On one hand, the current development of policies and activities related to smart cities technology is reaching a high degree of maturity. On the other hand, this development in the cities is not accompanied by a similar development in rural areas. Thus, two facts are exposed: high tech and economic development among Smart Cities tendencies, and complete absence of knowledge and information in rural areas, i.e. "Smart GAP". This gap emerges as an opportunity for Guadalinfo, and for Living Labs in general, because of their adaptability and capability to influence, through direct links, the regional policy makers.

Considering both these aspects, Guadalinfo is a perfect instrument to fill the GAP by linking high-tech Smart City productions and rural and citizen needs. In concrete terms, the significant steps of actions and iterations executed and designed to overcome the new digital gap are the following: Detecting the gap; definition & awareness; strategic definition. Currently the strategic endorsement is a reality and next actions can be seen as an iterative design: Strategy (Regional Policy making) --> Living Labs (Smart Agents) --> Activities design (Stakeholder Engagement).

End-user engagement

The necessity for action and the project concept itself emerged from the user involvement, by listening to people through our main value: the Guadalinfo Living Lab network. It has required an active approach in detecting needs and including a human perspective in the global technological and scientific tendencies - opening up and challenging exclusion and elitism. The rural gap seems clear, but we also refer to a "Citizens-Smart Tech" Gap. For example, thinking about the most technologically advanced building: compact fluorescent lights, solar panels, automatic doors and lighting, etc. all monitored by a huge number of sensors; but is it taking into account the human perspective? Were the bus stops near the building considered, enabling citizens to avoid the use of private cars? What kinds of materials were used in the construction? We are considering not only science but citizen science. Thus, it was crucial to involve end-users since the early beginning.

Involvement of other stakeholders

This actuation is being designed with aiming at the quadruple helix model, based on the new Living Lab innovation model: Universities, Governments, Companies and Citizens.

Academia:

In the iteration process of this project, the bigger efforts were executed on the Government and Citizens helix. Once the commitment in these two helixes is mature and reinforced, efforts in balancing the four-helix model are required. Therefore, we are currently designing the incorporation of the University of Granada into the case, tracing synergies and complementarities among their spinoff-Fab Lab vision and the Living Lab network/system. The main objective is to merge into one model and conception.

Public sector:

Since the early beginning it was clear that the main objective was to create a suitable environment where relations and links among policy makers and citizenship flow freely. The main driver in creating the ecosystem was the Living Lab network and its approach. It is performing this strategic and political endorsement that enabled the capitalization of the project.

Private sector:

Considering the above described environment including government (policy makers) and citizens, it was easy to engage with private entities. Taking advantage of the capillarity and political vehicle, Guadalinfo LL network (composed of nearly 800 rural labs) emerged as the perfect instrument to engage with the local and regional private entities, encouraging them to support the working group activities. The main lesson learnt is that engaging these entities is easy after a trustful environment involving end-users (citizens) is created.

EXPLORATION

Two significant steps were taken at the early beginning of the project in terms of user involvement:

1. Detecting the gap. In our citizen innovation lab conception, the user/citizen is in the centre of the action. It confers a privileged position in detecting both user needs and exclusive tendencies to them. Supporting and boosting this bottom-up permeability is a must.
2. Definition & awareness. Researching on the current knowledge and information on Smart Cities, we realized that the concept was unknown in rural areas, but also that most of current smart strategies were excluding rural areas. In this way, dynamic activity was designed and executed, where stakeholders (citizens, promoters, innovation agents ...) were motivated to construct the "Smart Rural Concept". At first, the action was held in a limited number of Living Labs among significant rural nodes, aiming to obtain enough data to trace realistic and contextualized strategies within the whole Guadalinfo Living Lab network.

The workshops consisted of three main parts: initial speech, dynamic section (working in groups) and conclusions. The main lesson learnt was related to the question on how to reach the end-users: this can be best achieved through training agents, who will be in charge of replicating and contextualizing the workshop.

EXPERIMENTATION

After consolidating the strategic endorsement, prototyping and testing can be seen as an iterative process:

- Strategy (Regional Policy making)
- Living Labs (Smart Agents)
- Activities Design (Stakeholder engagement).

As a result of the initial research and awareness of the action, as a bottom-up citizen driven process, the two main sectors of intervention were defined as:

- Citizen-participation working together with local administration (municipalities);
- Smart tourism as an economic opportunity.

In this way more hot-spot actions could be performed through establishing two working groups composed of Local Innovation Agents, local stakeholders and significant end-users representing 8-10 Living Labs influencing areas. The main activities involving end-users, stakeholders and Local Innovation Agents (Smart Agents) included: Definition of the sector with problems and opportunities (from the rural perspective), mapping of stakeholders and resources, citizen awareness and engagement.

One lesson from this phase is that the methodological approach works. Training ambassadors, local innovation agents and/or volunteers that engage with the local communities to replicate and spread the word has been successful.

PROJECT OUTCOME - EVALUATION AND FOLLOW-UP

The main outcome of the project is the strategic definition & policy framework. As a bottom-up process, data collected together with end-users and stakeholders resulted in the definition of specific strategic action lines to be included in the global Guadalinfo LL Strategic Plan. One line of action was defined, proposed and approved by Consortium council members (Regional Government and the eight County Councils): "Developing AndalucíaSmart": Smart Cities-Regions under this line of action are included in all actions aimed at considering that the citizen is the centre of every process, politics or technology related to Smart Cities. Everything starts in the citizens (their needs), in equality conditions, so that they can participate in the execution, and everything ends in the citizens (as beneficiary).

The main cities of Andalucia have strategic plans and actions intended to develop these politics, services and technologies. We cannot ignore the rural zones. This Line of Action groups together three actions: Training in Smart Cities, Empowering Citizens and Open Smart Lab (www.guadalinfo.es/tenemosunplanparati/).

Thus, we can extract the main capitalization aspects of the project:

- Policy recommendation: through the strategic line described above, political and governmental endorsement is reality and budget supporting the activities is ensured.
- Policy learning: to be executed as a bottom-up process.
- Scaling out: main activities and research were scaled out and replicated in similar rural areas or villages through our Living Lab network.
- Scaling up: using the rural Living Lab and the Smart Agent, each local initiative is potentially growing from villages to counties

Methodologies used in project

The following methodologies were used during the course of the project:

- Living Lab methodologies
- Design Thinking
- Observation / Shadowing
- How might we / other workshop to create first ideas or understand the problem
- Service design workshop / other workshop to develop the solution together
- Community Building
- Social media

More specifically on Living Lab methodologies, design thinking and observation: By setting up a Smart Agent Network to execute concrete (and permanent revision) strategies, we are adding a "Responsible" meaning to the "Research & Innovation" (RRI). The four clusters in RRI are considered within the overall process:

- Diversity and inclusion
- Openness and transparency
- Anticipation and reflection
- Responsiveness and adaptive change

With the support of the Living Lab network, several workshops were run at the very beginning (workshops for the first ideas / service definition). These workshops helped to identify interested agents, end-users and stakeholders. These key actors were engaged in two working groups that defined the areas of interest, policy requirements and activities to run under the Living Lab umbrella. Social media was used for dissemination.

Category: tailor

The project was identified as tailor on the approach towards the innovation process; iterative processes are obvious in our approach, but the set of tools are also contextualized to the area of application together with all the components of the working groups. Also the iterator category may apply, as sometimes, and depending on the context of applications, pre-defined sets of tools are used: hackathons, personas, game jams, storytelling, etc.

Further information about the case:

Living Lab: **Guadalinfo**

Contact: **Luis Navarro Lopez (luis.navarro.lopez@guadalinfo.es)**

Case Study

Learnings

These cases tell four stories of real-life living lab activities that have all made a difference in their own region and domain. All the presented cases vary by their context and approach towards Living Lab methodologies and the innovation process. However, the common elements of the Living Lab approach have been relevant for all of them: multi-method approach, user engagement, multi-stakeholder participation, real-life setting and co-creation.

The highlights brought up by the cases reveal some essential learnings for all types of experiments aiming at involving stakeholders, placing end-users at the center.

Continuous contact to the end-users:

"It could be easy to reflect and expose that this project or this Lab approach appears as a result of expertise thinking of engineers, politicians or ICT gurus belonging to our company but, fortunately, it is not the case. It emerged as an opportunity through listening to the territory. Thus, most important lesson learnt: being in direct and permanent contact with end-users creates the perfect environment for serendipity and opportunities"

Guadalinfo SmartLab

"End-user engagement is more like a marathon race rather than 100m sprint. It requires persistence, endurance, and flexibility to adjust to end-users needs, to earn and maintain this engagement."

PA4ALL FRACTALS

"For us, the user researcher is at the core of the Living Lab process, what they do is capture the end user behavior. It is important for this research to be ongoing, prolonged and longitudinal, and one of the ways to capture data is through wearables."

imec m-RESIST

Reaching and rewarding the users:

"The main lesson has been related to how to reach the end-users: this can be best achieved through training agents, who will be in charge of replicating and contextualizing the workshop."

Guadalinfo SmartLab

"One of the solutions chosen by the steering committee of the study comes from a home-based caregiver who was surprised and amazed to find her solution adopted. The involvement of users allows both the identification of solutions adapted to the field but also allows them to develop a sense of self-confidence, recognition and prompts the questioning of their practices and leads them to become force of proposals."I have some ideas you see, it's thanks to you! The week after seeing you and talking to you about the job, it gave me that idea. " Ms T."

Autonom'lab Care(e)rs Rally

Involvement of different kinds of users:

"Regarding IoT, we would suggest to have a broader look on the community, i.e to engage in the co-creation with other profiles different from those considered as "targets". Even if they are not going to be end-consumers of the product/service they are going to force you to "have a look out of the box" and that is when serendipity and opportunities spark."

Guadalinfo SmartLab

Involvement of all stakeholders:

"Their [government's] position brought to PA4ALL Living Lab credibility, so that farmers (who are reluctantly approaching new initiatives) were encouraged to join the initiative. "

PA4ALL FRACTALS

"I would try to engage with the research bodies such as Universities since the early beginning. At the actual development point it is requiring so much effort to involve them in the action. We would try to co-design the action involving researchers."

Guadalinfo SmartLab

"The main lesson learnt is that engaging these [private] entities is easy after a trustful environment involving end-users (citizens) is created."

Guadalinfo SmartLab

"A very important component in treating patients is the social entourage of the patient, their friends and family."

imec m-RESIST

"When working together with the private sector, it is important to ensure that the goals of the business are well aligned with the goals of the approach of the project. Although it sounds very simple, this is something that is often missed across projects."

imec m-RESIST

Benefits of a real-life setting:

"Field professionals emphasized the value of finding themselves in the proposed life scenarios and finding out how their opinions had been listened to."

Autonom'lab Care(e)rs Rally

"One of the learnings is that you don't always have to make things too difficult - often theoretical solutions or scenarios are too complicated to actually work in daily life. The big advantage in working closely together with end-users is that you get an immediate reality check."

imec m-RESIST

Several approaches for processes and tools:

"From the four approaches provided, the m-resist project fits best in the category of linearizers. Although some standardized tools were used throughout the project (such as personas, MVPs) and iterative processes were followed (such as SCRUM), we iterate on the consequential phases as a linearizer."

imec m-RESIST

"The project was identified as tailor on the approach towards the innovation process. [...] Also the iterator category may apply, as sometimes, and depending of the context of applications, pre-defined sets of tools are used."

Guadalinfo SmartLab

Chapter 4

Practical Application of Living Lab Approach

End-user engagement toolkit

As presented in the case examples in the previous chapter, for the engagement of end-users in the experiments a vast number of different methods and tools exist - the challenge is in finding relevant information and selecting appropriate means. A specific toolkit was created by ENoLL in the context of the European IoT Large-Scale Pilots programme to guide the researchers and practitioners through the innovation processes, with a special focus on user-engagement. This toolkit is available online (www.u4iot.eu/end-user-engagement-toolkit) and it comprises over 40 different methods and tools found across literature and online, put together in a format that follows the different phases along the innovation process. These three phases, exploration, experimentation and evaluation (presented in the introductory chapter), have been further divided into 3-5 iterations.

Although organized in a manner that the phases and iterations could be followed in a step-by-step manner, from beginning until the end, the purpose of the entire process is that it is followed in an iterative manner. This means that the different phases and iterations in the innovation processes are often overlapping, repeating, and mixing in order. Throughout the journey the need to jump back and forth between the different phases is to be noticed.

In addition, practitioners may customize the tools according to their specific needs. Although the tools within the toolkit can be followed according to the pre-defined instructions as described by the tool, the situation is sometimes calling for a tailored approach.

The four case studies in the previous chapter each represent a different approach to following the process and usage of tools, and the toolkit aims to provide a selection of possibilities for the users of the toolkit, rather than a pre-defined pathway to innovation. However, the tools have been organized to follow four different tracks, each aiming to guide the projects in their selection of the different tools for their needs:

A. Use cases: Defining use cases and specifying requirements, as well as validating them

B. Co-creation: of user needs and solutions, specific tools & methodologies for co-creation

C. Prototyping & Testing: First tests and Minimum Viable Products (MVPs), assessments and evaluations, user acceptance

D. User research: Methodologies for user research

When planning the experiments, some specific questions need to be taken into account. Common challenges are related to the selection of the users and the sustainability of the results that requires the participation of all the quadruple helix actors. In the following sub-chapters the Living Lab experts from three ENoLL Living Labs – Botnia Living Lab, Bristol Living Lab and imec.livinglabs – share their knowledge in tackling these issues with concrete advice. In addition to the guidance on user selection introduced in the next sub-chapter, three practical examples of Living Lab methodologies on the multi-stakeholder involvement are presented: the Bristol Approach, Tips&Tricks and Panel Management.

U4IoT toolkit for end-user engagement tools and methods online:
www.u4iot.eu/end-user-engagement-toolkit

User selection

Anna Ståhlbröst (Botnia Living Lab)

An important consideration with user involvement is to know who to involve in the different innovation stages. The aim of including users in the different phases of innovation process is to reduce the market risks. Here users, or customers, with different qualifications should be included in the innovation processes based on their suitability to achieve the expected output. Here, the requesting customers provide ideas for new products from the basis of their needs (Enkel, Perez-Freije & Gassmann, 2005).

How much a requesting customer can contribute is often dependent on the companies' ability to capture their ideas and knowledge, which often are expressed in terms of complaints or suggestions. In this case complaints are often anchored to a specific product; hence the innovativeness in these complaints is limited. The launching customer is integrated right from the development phases to stimulate design or participate in development activities. The reference customers supply their experience of using different applications; hence their ability to refer to their previous experience becomes important. The first buyer customer however, plays a more passive role in the development. Finally, the lead users should and could be involved in all stages of the development process, although the same customer does not necessarily always represent them (Enkel, Perez-Freije & Gassmann, 2005).

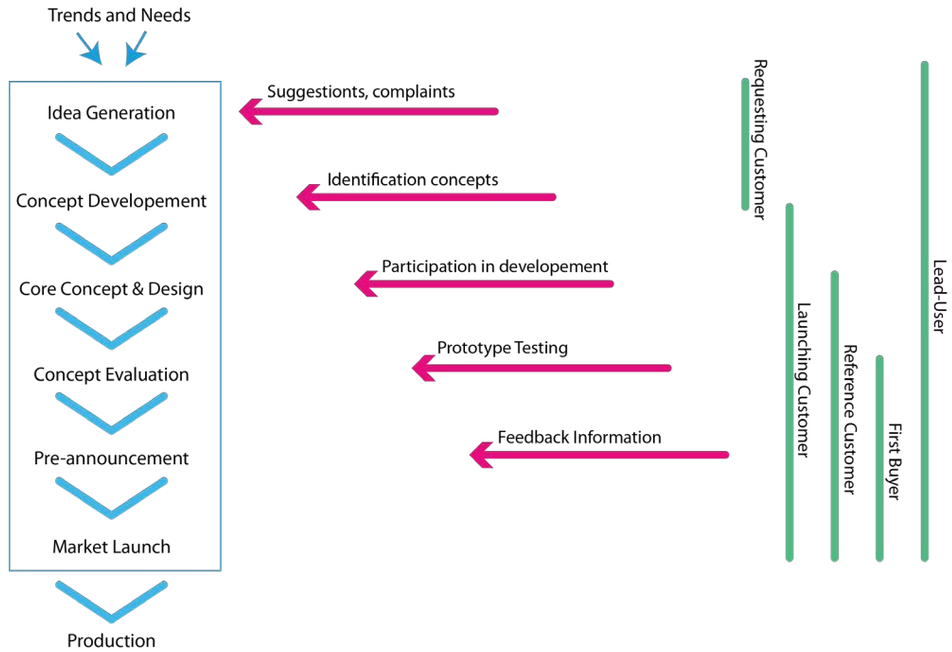

Figure - Customer Involvement in Innovation Developement Porcesses,
Note: Adapted from Enkel, Perez-Freije & Gassmann (2005)

There is one ground rule when recruiting users to be included in user involvement activities and that is that the involved user should represent the actual end-use as well as possible. This is something that needs to be considered when users from a specific group of the society are involved.

In order to select people that are suited for involvement activities, such as tests, there are many factors to consider. Some guidelines for selecting users to ensure that they are as representative as possible include the following:

For further reading: Ståhlbröst, A., & Bergvall-Kåreborn, B. 2013. Voluntary Contributors in Open Innovation Processes. In J. S. Z. W. Eriksson Lundström, M.; Hrastinski, S.; Edenius, M.; Ågerfalk, P.J (Ed.), Managing Open Innovation Technologies. Heidelberg: Springer.

- Strive to maximize the difference between different categories of users.
- Involve users who are flexible and willing to change and who have a strong social competence. One single saboteur can destroy a development project completely.
- The participation must be voluntary.
- Strive for a balanced distribution by gender under the circumstances that the distribution occurs in the user group. Traditionally it has been shown that male participants have led to a development more focused on technical performance, while female participation has led to a development more focused on human needs.
- To maximize the difference among the use categories, all kind of ages need to be represented.
- Focus in the selection should be on the users who are the least knowledgeable about the area.
- Do not necessarily reward the users for their involvement. Focus more on finding a good combination of the four Fs that motivates participation: Fun, Fame, Fortune and Fulfilment.

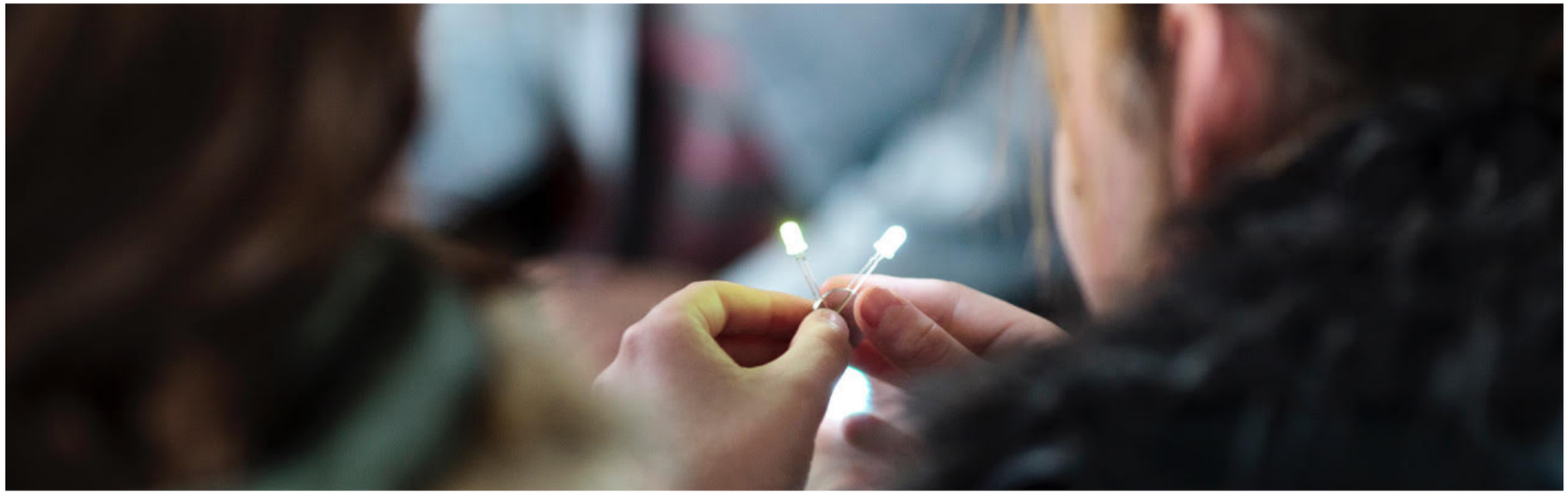

Photo by Ibolya Feher, courtesy of Knowle West Media Centre

Quadruple helix involvement - activities and tools involving all stakeholders

Penny Evans (Bristol Living Lab)

Botnia Living Lab defines the Quadruple Helix approach as a way of working "that means the inclusion of representatives from public sector, universities, companies and citizens in the innovation process."

Knowle West Media Centre, home of Bristol Living Lab, defines a Living Lab as a place where these stakeholders can come together to co-design tools, practices and technologies that address local challenges, in a collaborative process of innovation, testing and exploring new possibilities. Tools and practices are co-designed through exchange and dialogue with local people, national and international networks, organisations, academics and individuals with expertise in relevant fields. Bristol Living Lab uses a range of creative approaches and digital tools (including IoT devices) to gather data to support people to tackle issues that are important to them: from damp homes and data sovereignty to social isolation and poor air quality.

An 'enabler-driven' Living Lab facilitates "strategy development through action", where information is collected and used so a range of stakeholders can co-create knowledge through processes that create parity. Through its established networks, a Living Lab like Bristol Living Lab can act as a 'broker' and connector between the members of the Quadruple Helix, ensuring that each stakeholder can contribute their knowledge and experience by facilitating introductions between different stakeholders and offering training and advice for stakeholders with little previous experience of working within communities.

Knowle West Media Centre (KWMC) has developed "The Bristol Approach to Citizen Sensing", which brings together Quadruple Helix stakeholders.

Communities and their needs are central to Knowle West Media Centre's work as Bristol Living Lab. The organisation has 20 years of experience of working in Knowle West (a neighbourhood of approximately 20,000 people in Bristol, UK that features high in the government's deprivation indices), and has developed strong relationships and built up trust with individuals, groups and organisations. The BACS programme puts people and their skills, priorities and know-how at the centre of innovation, using a framework that Living Labs and

other stakeholders of the Quadruple Helix can also employ to guide their practice and innovation to ensure it not only meets their needs but also addresses wider social concerns including social inequality, lack of inclusion and diversity in smart city development.

Working with public sector stakeholder Bristol City Council and the Barcelona-based innovation company Ideas for Change, KWMC has developed "The Bristol Approach" to Citizen Sensing: a six-step framework for delivering technology and innovation projects that use IoT devices, sensors and 'smart' technology to ensure that they place communities and their priorities at the heart of innovation. Rather than 'pushing' technology or pre-determined 'solutions' onto people, The Bristol Approach focuses on supporting people to work together to 'pull-in' the knowledge, technology and resources needed to tackle a problem.

BACS is a process where citizens build, use, or act as, sensors, for example identifying and gathering information (or 'data') that will help them to tackle an issue that's important to them. This sensing process could involve creating a bespoke temperature sensor from scratch or using a piece of technology that already has an in-built sensor, like a smartphone.

At the heart of BACS is the development of a 'city commons', where resources, tools, expertise and technologies are shared and used for the common good. A key 'commons' principle is that of the 'low floor/high ceiling', which ensures there are no barriers to taking part ('a low floor') but that every stakeholder can be challenged to the best of their abilities ('a high ceiling'). Through the framework, people are able to become more confident users and producers of 'smart technology' rather than consumers subject to a technology-led 'smart city', while public sector, academic and business stakeholders gain a greater understanding of community issues and priorities.

In 2015-2016 KWMC used the six steps of The Bristol Approach to support citizens of East Bristol to identify issues that were important within their community and which technology could be used to tackle. Following a period of engagement, KWMC discovered that damp and mould in homes was a significant problem for many people. Through a programme of practical workshops, 'hack days', making sessions and regular meetings, KWMC supported people from different backgrounds to come together to identify key actions and develop and test a 'damp-busting' system which included: frog-shaped temperature and humidity sensors, digital interfaces to make sense of the gathered data, mapping tools to visualise the scale of the problem, and training for volunteers to tackle the problem on a practical level. The collaborative testing of the Approach in this 'Dampbusters' pilot brought together universities, businesses, technologists and open data specialists, city council representatives, artists, architects, housing associations and citizens.

The Bristol Approach offers a process, set of resources and way of thinking about data and its role, where:

- Human behaviour is taken more seriously than technology
- There is plenty of use generation and sharing of evidence
- There is a focus on developing data skills
- Work is integrated with other work in cities
- Hardware and technology are used as and when they are useful
- Citizens' roles are central
- Projects are open and shared
- Opportunities for new business models and enterprises are created

The 2015 report 'Rethinking Smart Cities From The Ground Up' (T. Saunders & P. Baeck, 2015, Nesta) identified the absence of these features as something that could hold smart cities back from delivering real value. The Bristol Approach, through further iterations, promises a process that has 'smarter' citizens at its heart and which will help to decrease and diminish existing patterns of digital and social exclusion.

Bristol "Tips & Tricks" initiative: supporting stakeholders in reflective practice

In order to support individual stakeholders to explore different ways of working, learning and collaborating with others, KWMC has transformed many of the principles, practices and lessons it has developed over 20 years into a series of learning resources called 'Tips & Tricks' which were compiled after consultation and collaboration with female activists from South Bristol, a group of academics, and Living Labs from across the ENoLL network. There are three sets of 20 recommendations covering 'Tips and Tricks':

- From community activists;
- For academics working with community activists;
- For Living Labs working with citizens.

The advice ranges from being 'dogged but not inflexible' to remembering that experts should be 'on tap, not on top'. The Tips & Tricks resource pack can be used in a variety of ways: from being a useful discussion-starter to gauge differences of opinion and interpretation within a team; to raising awareness of the opportunities and challenges presented by different cultures, disciplines, languages and expectations.

Stakeholder management using the Bristol approach

Penny Evans (Bristol Living Lab)

A key factor in successful stakeholder management is the identification of relevant community and city challenges. By tailoring the content, scope and focus of any project or programme to the interests and priorities of the people and partners working with it, projects are thus defined through co-design and co-production and have an inclusive approach.

The approach used by Bristol Living Lab ensures the inclusion of individuals and groups at risk of social exclusion and, consequently, digital and technological exclusion. This approach

works to address the inequality of access to new technologies and means of production, such as AI, robotics and digital fabrication, thereby enabling active citizenship, citizen participation and equality of access to city opportunities. This approach ensures that no technology or pre-determined 'solution' is imposed on people and that stakeholder-citizens are supported to collaborate to create the change they want to see and the tools that will help them achieve it.

The practice of identifying challenges should be able to be translated to anywhere on a global basis and is likely to both uncover known common urban and regional issues and reveal concerns that are less highly profiled but equally important. For example, during the 'Women and Data Futures' project at Bristol Living Lab, it was discovered that young mothers felt that their lack of privacy online was a big issue, including how and where their personal information was being shared without their knowledge and the value and ownership of this information.

The following section outlines key learnings from The Bristol Approach:

1. It is important to be patient and open-minded, as identifying challenges that could be tackled within a community takes time and requires open, two-way communication. An open and transparent selection process for choosing the challenge is essential.
2. When challenges have been identified, it is essential to uncover what is already known and what knowledge or information is needed or could be collected for the project. Look to understand the challenge from a range of different perspectives and begin to investigate who will benefit from solving the problem or concern, and who already is aware and has previous knowledge and expertise. Consider if there are any other stakeholders who should be invited to participate. Finally, seek to establish partnerships with those who have networks and communication channels that can be utilised to strengthen and support the work. These collaborations can lead to the successful broadening of networks.
3. Develop a programme that offers a range of activities that can involve all partners - members of the Quadruple Helix and beyond. These other members could include artists, creative technologists, academics, social enterprises and public sector organisations.
4. If your project involves designing a prototype or product, design iteratively. It is important to test a basic working prototype of a whole system, rather than perfect each piece in isolation. Ensure that any workshops or co-design sessions take place in an accessible neighbourhood and venue so that travel is not a barrier to attendance for stakeholders.
5. Take steps to address concerns that may arise about the user experience: don't privilege or prioritise technology and be sure to remember to make engagement with technologies personal, fun and engaging. By demystifying terms like 'data' and taking time to explain how different technologies work during workshops helps to create an environment of transparency and inclusivity where everyone is valued for their knowledge and expertise – whether that knowledge is technical or not.
6. Create an engagement team who can support stakeholders to test the prototype and learn new skills to help them apply the technologies and solutions. Encourage openness and share your findings with other communities facing the same challenges so they can utilise the tools to effect change.
7. Finally, celebrate achievements together: marking achievements, acknowledging the contributions that have been made, and saying thanks is essential to maintain interest and commitment.

Photo courtesy of Knowle West Media Centre

More details about The Bristol Approach can be found at www.kwmc.org.uk/bristolapproach.

More information on Tips & Tricks at: https://shop.kwmc.org.uk

As stated above, working collaboratively is key to the success of projects. This collaborative work should be structured by a clear set of aims and objectives, an understanding of the distinctive assets and expertise that each partner brings, and space for review. Iteration and reflective learning. This needs to ensure that technological developments don't act to increase and amplify existing patterns of social and digital exclusion but moreover allow people to gain skills and contribute knowledge.

Bristol Living Lab's evaluation approach is aligned with action research, so it nurtures reflective practice for all stakeholders. The main aim of effective stakeholder engagement is to create an environment where technology, knowledge, expertise and collaboration can be combined to co-create solutions and opportunities that generate value and legacy for all.

Panel management - putting the life in the Living Lab

Koen Vervoort (imec.livinglabs)

Within a multiple helix Living Lab environment, user involvement is an important key to success, although way too often this aspect is forgotten by the different stakeholders in the Living Lab.

Most Living Lab initiatives have a clear view on what they want to achieve and create beautiful projects & business plans to make sure that all involved stakeholders can profit from the results. Nevertheless, many initiatives forget to think - in advance - about which 'users' they want to involve and how they're going to deal with the management of that panel.

What's the role of the panel within the Living Lab? Which activities do they need to perform? What are the parameters of the panel (quantitative vs. qualitative, diversity, timeframes...)? Who do we need? Where do we find them? How are we going to support & protect them (recruitment, privacy, helpdesk, rewarding...)?

Furthermore, it is important to involve all possible users in a Living Lab panel and therefore to take a wider approach on who needs to be involved. For example, if you want to involve lonely seniors to solve the problem of their isolation, it's essential that you involve their caregivers and family or even the general practitioners as well.

Involving users in Open Innovation and Living Lab projects requires specific skills and consists of different aspects. Foremost panel management facilitates the interaction between end-users, researchers, instigators/clients and addresses the tension between the different expectations of these stakeholders.

Over the last years imec.livinglabs developed a two-step method to keep a project-overview of the defined feedback steps of the panel (segments): first to map all involved stakeholders in a Living Lab panel and then to organize that panel in a panel matrix.

Panel circles

Organizing at least one workshop with the Living Lab team and/or different stakeholders within the initiative offers the opportunity to broaden the views of the (sub)groups of 'users' who are involved in relation to the problem definition(s) the Living Lab is tackling.

Brainstorming about the problem and the involved stakeholders will widen the view on the panel and will likely lead to the identification of new (sub)groups that were not identified before.

By mapping all the (new) identified (sub)groups into a panel circle, the relationships between these groups will become clearer and more structured/clustered.

Naturally the (sub)groups in the middle of the circle will be more actively involved in the project as the ones out of the centre of the panel circle.

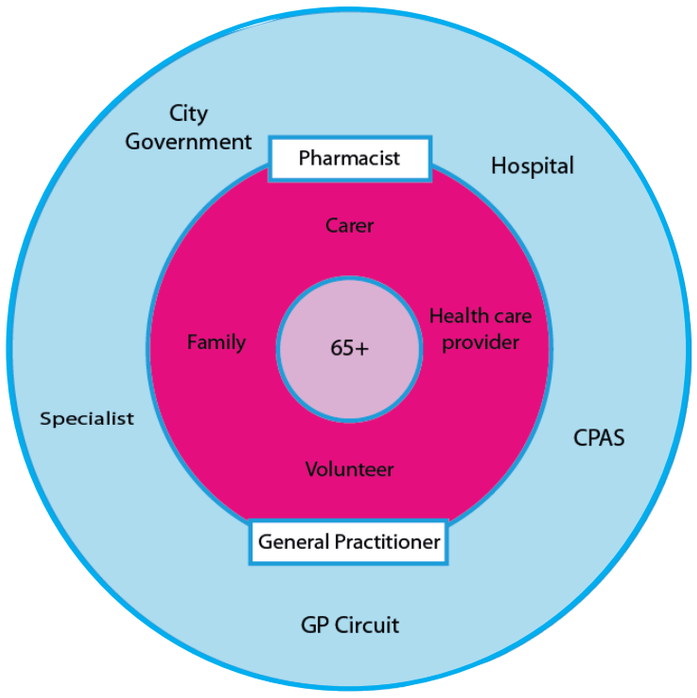

Figure - Panel Circles

Panel matrix

Once all (sub)groups are identified and clustered into the panel circle, these (sub)groups can easily be transferred to a panel matrix.

This matrix combines the groups with the defined research/user activities of the project/initiative. It offers the possibility to create an overview on which groups would have to be involved in which activities.

By matching them with an 'X', all stakeholders get better insights on what is expected from users, which research methods will be used and what material and panel resources are available in order to be able to build up recruitment campaigns, support structures and reward strategies. Naturally this is a working document which can be updated based on the changes or findings in the project/initiative.

Finally making this matrix WORTHCASE (who/what/when, organization, recruitment, timing, help & support, communication, attrition, succeed & estimation) will increase the possibilities to adjust strategies if necessary without losing the initial planning from sight.

	Projectphase 1				Projectphase 2				Projectphase 3			
	Intake survey	Activity 1	Activity 2	...	Co-creation session	Activity 1	Activity 2	...	Field trial	Activity 1	Activity 2	...
Senior 65+												
Subgroup 1												
Subgroup 2												
Health care provider												
Subgroup 1												
Subgroup 2												
Carers												
Volunteers												
Family members												
Pharmacists												
General Practitioners												
Specialists												
Hospital employees												
Members city government												
CPAS-employees												
Gp-circuit members												
...												

Timeline Project X

Figure - Panel Matrix

If you want more information about this method or the WORTHCASE matrix, please contact Koen Vervoort from imec.livinglabs (koen.vervoort@imec.be).

Conclusions

The Living Lab, be it defined as a methodology, ecosystem or community, is foremost about bringing people together to innovate. It is the practitioners driving the experiments, people giving their valuable contributions as end-users, public administrators, company representatives or academic researchers.

Throughout this handbook, the different aspects have been highlighted that make the Living Lab approach successful in tackling the innovation challenges. The first chapter introduces the context with key Living Lab characteristics that are typical for this kind of innovation activities: multi-method approach, user engagement, multi-stakeholder participation, real-life setting and co-creation. Three main elements have been distinguished within Living Lab projects, following the innovation development stages:

Exploration: getting to know the 'current state' and designing possible 'future states'

Experimentation: real-life testing of one or more proposed 'future states'

Evaluation: assessing the impact of the experiment with regards to the 'current state' in order to iterate the 'future state'

The IoT context brings in certain conditions that need to be taken into account with the Living Lab activities and methodologies. The FormIT methodology considers these challenges with presenting the innovation process with three main phases to move IoT systems from ideas that solve societal challenges to solutions that are diffused to the identified customers or user segments.

The four Living Lab case studies, all with their different approaches to innovation process and selection of tools as well as operational domains, expose the variety of Living Lab activities. However, as presented in the learnings from the case studies, they all share the common elements of Living Labs and emphasize foremost the human-driven perspective.

Finally, for the guidance of the practical application of the Living Lab approach, a specific end-user engagement toolkit has been developed to support the selection of an appropriate methodology or tool (available at www.u4iot.eu/end-user-engagement-toolkit). Necessary considerations in terms of user selection are to be taken into account when planning the experiments. In addition to the end-user engagement, the whole quadruple helix approach, i.e. inclusion of representatives from public sector, universities, companies and citizens/end-users is to be stressed in the innovation process. Practical examples of concrete tools as well as lessons learned from the user selection and multi-stakeholder engagement specifically in IoT context are presented by three ENoLL Living Labs: Botnia Living Lab, Bristol Living Lab and imec.livinglabs. Further examples are also available through the European Network of Living Labs website (www.openlivinglabs.eu).

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