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Tr@nsnet Living Lab Model:

A Living Lab Model to accelerate the ecological transition

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TransNet Living Lab Model: A Living Lab Model to accelerate the Ecological Transition

This document runs as part of the European cooperation Tr@nsnet project. This European project, financed by FEDER funds, and brought to fruition by the consortium led by the French Toulouse III University - Paul Sabatier (UT3), includes the participation of the Foundation for Energy and Environmental Sustainability (Funseam), the Polytechnic University of Madrid (UPM), the University of Lisbon (FCUL), the University of Beira Interior (UBI), the University of La Rochelle (URL), CIRCE Foundation - Centre for Energy Resources and Consumption (CIRCE) and the Technological Corporation of Andalusia (CTA). It aims to contribute to the challenge of ecological transition by defining a new model of Living Lab in the context of open innovation.

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INTRODUCTION

Climate change and greenhouse gas (GHG) emissions into the atmosphere are creating increasingly severe and irreversible social, economic and environmental impacts. It is our greatest challenge, a problem on a global scale that must be faced decisively and urgently, and the energy sector is called upon to play a vital role in addressing this problem.

Within a context like this, achieving a decarbonized economy requires a great effort in innovation. In recent decades, innovation and technological development have advanced at an unprecedented rate, but the magnitude of the climate challenge not only requires more speed but also the commitment of all stakeholders for a fair and inclusive energy transformation.

And this is precisely where Living Labs comes very much into play as they are tools for innovation and transformation of our productive model and our behavioural patterns as citizens. Living Labs have emerged around the world as key and effective research infrastructures, involving different actors in an open, iterative, and user-centred innovation ecosystem, in which co-creation is encouraged in a real environment.

From a model of innovation that focuses on technological aspects, we are moving towards new environments based on collaboration between the academic world, the private sector and industry, the government and the direct participation of society as a whole, to establish favourable scenarios for innovation and economic development.

In a process of innovation characterized by digitization and the advanced use of data, including the integration of regulatory innovation will make a decisive contribution to responding to the social and environmental challenges of the ecological transition. However, the implementation of all Living Labs is not exempt from challenges and aspects that need to be taken into account.

With the aim of overcoming all these issues, the European project Tr@nsnet[1]

sought to define and design a Living Lab model that, based on technological innovation, could also act as a support for social and regulatory innovation, which in turn would respond to the demands of society and the market related to the ecological transition.

Against this backdrop, this study includes a proposal for a Living Lab model that promotes the integration of technological, social and regulatory innovation to achieve a decarbonized and sustainable economy. The proposal contemplates different tools that allow us to generate new systems of innovation, integrating the different communities, projects and technological developers and taking into account the territory in which they are located. This way, this open innovation tool is used to its full potential and the different actors can validate new technological proposals and new business models, interact with end users and establish relationships between interested parties.

The study is divided into different sections. The first section focuses on the relevance of innovation, of Living Labs in particular, in the ecological transition process. The second section focuses on particular tools that can help implement new models of innovation that favours the collaborative creation process and promotes user participation. For this entire process to be successful, it is essential that we implement robust governance and intersectoral collaboration mechanisms that resolve technological, social, and regulatory innovation challenges that will have the greatest positive impact on society as a whole.

1. Tr@nsnet is a transnational cooperation project co-financed by the Interreg Sudoe VB program (2014-2020) with FEDER funds, and made up of eight partners from Spain, France, Portugal:
   - Spain: Foundation for Energy and Environmental Sustainability (Funseam), Polytechnic University of Madrid (UPM), CIRCE Foundation - Centre for Energy Resources and Consumption (CIRCE) and Technological Foundation of Andalusia (CTA).
   - France: Université Toulouse III Paul Sabatier (UT3) and Université La Rochelle (ULR).
   - Portugal: Faculty of Sciences of the University of Lisbon (FCUL) and University of Beira Interior (UBI).

1 ECOLOGICAL TRANSITION, INNOVATION AND LIVING LABS

Joan Batalla-Bejerano and Manuel Villa-Arrieta (Funseam)

Climate change is our greatest challenge, a problem on a global scale that must be faced decisively and urgently, since it is causing increasingly severe and irreversible social, economic and environmental impacts. This change is the variation in the state of the climate due to the continuous increase in the temperature of the Earth's surface, due to the increase of greenhouse gas (GHG) emissions of anthropogenic origin. Global warming generates extreme weather conditions, melting glaciers and rising sea levels. It also creates abnormal climatic conditions that affect present generations, and will affect future ones, with increasingly worse consequences for our economies, the environment, health and daily life. GHG emissions into the atmosphere have been increasing mainly due to the use of fossil fuels. Therefore, the energy sector, which is primarily responsible for these emissions, is called upon to play a vital role in this great challenge facing humanity.

1.1 Innovation for the Ecological Transition

The Ecological Transition is the process of making the changes necessary to respond to the challenges stemming from climate change, changes that are made in production and consumption systems, in social and political institutions, in those responsible for innovation and in the population in general. It is a process that transforms the current situation into one of sustainable development, compatible with the planet's capacity to maintain human activities; all without altering the organization of economic activities. In the face of this enormous global challenge, the Energy Transition plays the biggest role in the Ecological Transition roadmap. It refers to a long-term structural change of energy systems that allows for the decarbonization of the economy. The energy sector is already working on specific objectives related to the reducing GHG emissions, improving energy efficiency and increasing renewable energies for the final use of energy, primarily in electricity generation.

Within this framework, reaching a decarbonized economy requires great effort in innovation. And, although in recent years it has been taking place at an unprecedented rate, there are multiple social and environmental challenges which usually require a deeper and more effective validation in addition to having the participation of all interested parties within the framework of a fair transformation process. Innovation refers to the process of introducing novelties to the market, either by modifying already existing elements in order to improve them, or implementing entirely new elements. In this process, open innovation is presented as a management model based on collaboration with people and entities external to the innovative entities to expand research and development to all possible sources of knowledge. Then, technological innovation refers to the creation of new or significantly improved products or production processes, which include more advanced techniques, components, materials or software than existing ones. Technological innovation gives rise to social changes framed in social innovation. This means new ideas that satisfy social needs and simultaneously create new collaborative relationships. These processes and the resulting innovations must be aligned with new regulatory environments that facilitate the entry into the market of new products, services or business models, protecting the interests of consumers and the population in general.

Because results from technological innovation can materialize immediate results, of the three innovative processes (technological, social and regulatory), changes stemming from technological innovation see results more quickly, especially given the ease of the innovator to mobilize their resources. In many cases, this advance produces a social innovation that is reflected in changes in society, albeit this innovation has a lower rate of variation than technological innovation. Finally, due to hierarchical components, regulatory innovation presents a rate of growth that is lower than the rate of technological and social innovation. Consequently, this has been problematic: on many occasions, technological innovations and their associated business models encounter regulatory barriers which prevent them from entering the market. That is why the difference between these three growth rates creates a delay in the solutions that have been called upon to deal with the challenges in the

Ecological Transition: it prevents the financing of technological and social innovations, the creation of regulatory frameworks according to the needs of innovations disruptive or effective protection of consumer interests.

When we talk about the challenge of the Ecological Transition, we mean the process of change which acts in accordance with a new model of sustainable development. This must be a fair process to allow all interested parties to adapt their resource management and transformation processes, including clean activities and productive processes with social responsibility. In terms of innovation, this challenge is reflected in the creation of a model that unifies the variation rate of the three types of innovation mentioned above: technological, social and regulatory (see Figure 1). As of today, the best tool we have to achieve this goal are Living Labs: evolving environments that reflect the paradigms of open innovation, and which we address below.

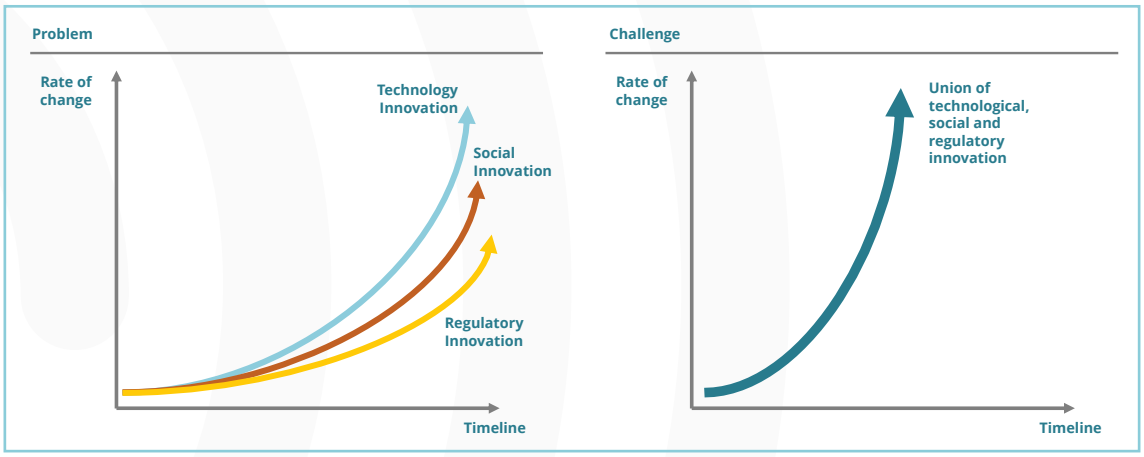

Figure 1: Differences between rates of change in technological, social and regulatory innovation.

1.2 Living Labs and the quadruple helix approach

Living Labs constitute a powerful open innovation tool in which innovative entities validate their new proposals by interacting with end users and establishing relationships between interested parties. In this open innovation framework, where innovators have traditionally responded to societal, public and private sector challenges, we can envisage the inclusion of new stake-

holders to address the challenge of integrating technological, social and regulatory innovation. Such is the case of regulators: agency, entity or body responsible as a governmental authority to exercise regulatory dominance and work towards regulatory innovation. Therefore, in the quest for a better innovation process to face the ecological transition, regulators are called to participate in the open innovation framework made possible by Living Labs. As the open innovation environments that they are, they add value to the market through the rapid creation of prototypes and their validation, thanks to co-creation processes that allow interaction with end users. The Living Labs act as intermediaries between the experimentation of innovations in controlled environments and their operation in the real environment of the market and society. With the support of Living Labs, innovation happens faster because innovators can test new ideas in an environment that has real consumers. Testing opens up access to capital for innovators, and consumers benefit because new technological products and their benefits are brought to market sooner. In these environments, direct communication between developers, companies, and regulators creates a more cohesive and supportive industry. In addition, successive trial and error testing within a controlled environment mitigates risks and unintended consequences, such as unseen security flaws when a new technology is accepted by the market too quickly [1].

The current Living Labs originate from a model that innovation theorists have been developing in recent years: the quadruple helix approach (4-helix). According to ENoLL (taking [2] as a reference), the 4-helix approach is based on a hybrid collaboration between the academic world (Academia), industry (Private Sector), government (Public Sector) and the participation of society in the figure of the people (People) to establish favourable scenarios for innovation and economic development. In innovation management theory, this approach is an evolution of the so-called triple helix, which can be considered a “core model” resulting from the exchange of knowledge between universities (higher education), industries (economy) and governments (multilevel). On the other hand, the quadruple helix, which includes society [3], ends up being a more complete model.

With the inclusion of society, people, which are represented by associations, non-profit organizations, etc., constitute a pillar of open innovation and are no longer mere sources of data. The 4-helix approach thus offers six characteristics that promote innovation: co-creation to compete and improve ideas, orchestration to ensure harmonious performance among stakeholders in the innovative process, active user participation thanks to the incentive of benefits tailored to their requirements, Multi Stakeholder Participation as a driving element of the helix, and openness to methodologies and configurations of innovation validation experiments that allow obtaining the best possible result. Thus, the 4-helix approach enhances the benefits of open innovation: it generates a network of stakeholders configured like a community in which ideas are shared in an effort to maintain a state of constant innovation. In this network, collaboration between companies allows them to approach new market niches and generate sources of income. In addition to this benefit, the collaboration between the stakeholders distributes responsibilities and this means that there is a distribution of resources necessary to innovate.

Although authors such as [3] discuss a quintuple helix approach to include environmental protection in innovation processes, the research carried out during the Tr@nsNet project has led us to include environmental sustainability as an innovation challenge and not as a new actor in the 4-helix approach. This is mainly because environmental sustainability has no representation of its own that can sit at the table next to Government, Academia, Industry and People in an innovation process. Better yet, environmental sustainability is a necessary cross-cutting element within the innovation processes carried out by the four representatives of the 4-helix approach. This is the vision we defend in the Tr@nsnet Living Lab Model to support the 4-helix approach to the challenges of the Ecological Transition towards environmental sustainability.

With the application of the 4-helix approach in mind and from a Living Labs community perspective, it can be said that we are currently living in a moment of momentum, a situation in which these environments are perceived as an attractive option for applying open innovation paradigms. This would be a positive step but it is not without possible pitfalls. The following points offer a

summary of several of these situations that the Living Labs community will have to face[2].

- The arrival of technologies with uncertain impact, such as Artificial Intelligence (AI), has created an evident distress in the population. The inclusion of the citizens in the decision-making allows for clearer approach to acceptable solutions. However, this could also be perceived as an easy way of compensating such distress with a cosmetic effect. It is not clear to what extent the Institutions will understand the user-centric approach as a way of placing the citizen in the centre of the innovation process, providing the citizen with a role of actor of their own lives, and not just a simple factor from which to obtain data or the appearance of legitimacy.
- The challenges that we are facing, such as the transformation of our mobility or the behavioural change associated with new energy management, are complex challenges which are oriented at the mid/long term. It is essential to invest in capacity building for all stakeholders, including our own citizens, in order to be able to tackle the challenges organically.
- The opportunity for business models in the Digital Transformation is the systemic change. In the years to come, it is essential that the Institutions and Regulators perceive this systemic change as something to be constructed in a co-creation process, not in a unique top-down approach to innovation. Only in this way would it be possible to integrate all actors and to make use of all available forces in our society, using Living Labs as social technologies to deploy the systemic change.
- Living Labs will have to work on the design of robust business models taking advantage of the systemic approach provided by the Digital Transformation. With a clear value proposition, it will be possible for the Living Labs to create trustworthy approaches to their ecosystems. This challenge should be tackled from the very outset of the Living Lab activity.
- The Digital Transformation widens digital divide with the unfavoured populations. For this, there is strong evidence. But there is also strong evidence that

2. The definition of the challenges for Living Labs is another contribution to this document from Fernando Vilariño – CVC-UAB.

the mechanisms of digital inclusion are becoming more and more effective, and the COVID-19 crisis has shown that there are opportunities in this field.

- The Network acts as scaling tool for the innovation. Organisations such as ENoLL will play a more relevant role in the years to come, representing a knowledge base that appears to be more and more consolidated, linking research with knowledge transfer.

The next few years will bring us an accelerated digital future in which, in addition to challenges, there are enormous opportunities for innovation. The deployment of exponential technologies –focused on data processing that increase in capacity and decrease in price and complexity as time goes by–, will make it possible to take advantage of the decentralization produced by open innovation: a level of environmental awareness in society, opportunities for university campuses to become social structures similar to small cities, and the competitive environment between companies, which are can foster entrepreneurship and collaboration. Within context of challenges and opportunities for innovation, in the following sections we present the model proposed by the Tr@nsnet project. It is a contribution to the current processes of innovation framed by digitization, advanced use of data, integration of regulatory innovation to validate inventions and creation of networks between different legal typologies of regional or cross-ecosystems, in which the heterogeneous technological networks can live up to the social and environmental challenges of the Ecological Transition.

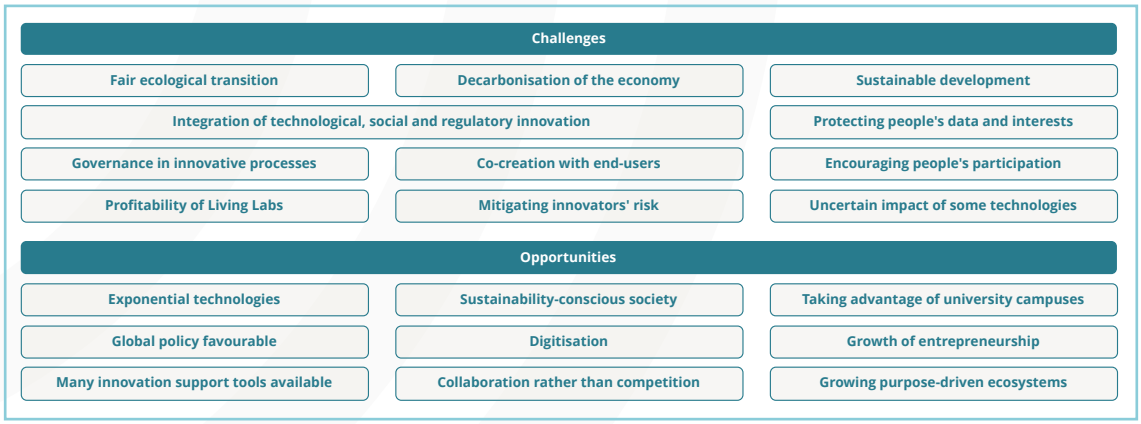

Figure 2: Summary of challenges and opportunities for innovation and Living Labs in the Ecological Transition.

1.3 The contribution of the Tr@nsnet project to the Ecological Transition

The Tr@nsnet project has the aim of contributing to the challenge of the Ecological Transition by defining a new Living Lab model in the context of open innovation. The proposal aims to provide a qualitative advantage that benefits the innovation ecosystems of the Sudoe region, opening up public research to industry and individuals, and contributing to the improvement of the Regional Innovation Systems (RIS) in Spain, France and Portugal. The contribution of the project is the result of a theoretical and empirical research that has led to the design of a new Living Lab model. This has been developed from the use of technological demonstrators from the consortium partners (Smart Light, IoT Home and electricity and thermal generation), and new demonstrators have been created (second life of electric batteries, water cycle and mobility), which have allowed new technological developments and business models to be tested and validated. In addition, the model proposed by Tr@nsnet seeks to support social and regulatory innovation with the aim of facilitating innovative agents to face the demands of society and the market related to the Ecological Transition. The research activities of the project were organized into three task groups (TG). The first two TGs had the objective of studying and designing replication processes and implementation of demonstrators and experiments, which have allowed enriching the model design work on the third TG. The scope of work of each TG was as follows:

TG1: In this TG, the focus of study was the processes of adaptation and transfer of a demonstrator from one environment to another, between the campus of one university and another, in order to capitalize on good practices and methods that were taken into account in TG3.

TG2: In this TG, new demonstrators were designed and implemented in the participating universities: new skills were acquired thanks to the collaboration and exchange of methods and processes of innovation. The

focus here was on the experiences of the people in the real-life environment, which served to enrich the work in TG3.

TG3: In this TG, the work of TG1 and TG2 was added to with new research activities/tasks and field work to create the new Living Lab model. The result of this TG constitutes the main product of the project: a model based on the open innovation paradigm that integrates the advantages of new innovation tools with the results of TG1 and TG2 activities.

There have been multiple and diverse activities carried out within the framework of the project to respond to the objectives set. In total, eleven high-level events were held, including face-to-face and online workshops and seminars (the online events being organized to overcome the logistical difficulties during the 2020 and 2021 health pandemic). Moreover, eighteen deliverables were completed, including internal reports and technical publications. These have been made available to the global research and innovation community. The results have been aimed at improving the innovation experiences of internal beneficiaries (the members of the consortium) and of external beneficiaries (the parties interested in ecological innovation in the Sudoe region). The project then meets its initial objective and presents in this document a Living Lab model that promotes the integration of technological, social and regulatory innovation required to face the challenges towards achieving a decarbonized and sustainable economy.

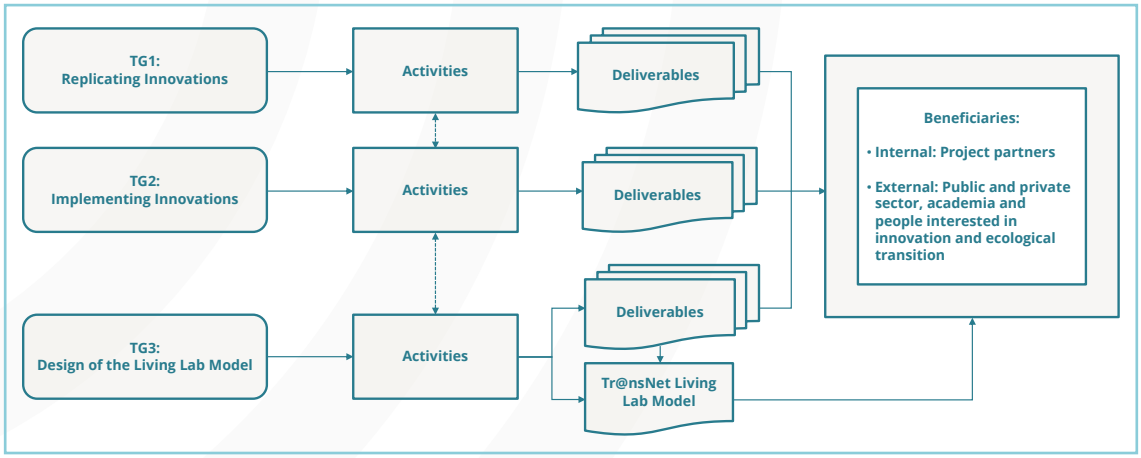

Figure 3: Structure of the Tr@nsnet consortium in activities and results. For more details see: https://www.irit.fr/TRANSNET/es/inicio/

1.4 A contribution to boost innovation in Living

Tr@nsnet presents a Living Lab model to broaden the scope of open innovation by supporting the European Network of Living Lab (ENoLL) quadruple helix (4-helix) approach to the challenges of the Ecological Transition. These are challenges related to the integration of heterogeneous networks made up of digitization, energy, mobility and the participation of people in the co-creation of innovations towards the decarbonization of the economy. The design of the model is based on three requirements identified by the partners of the Tr@nsnet project in their different experiences with innovation:

- Design a *generic model* aimed at managers of complex heterogeneous networks (digitization, energy, mobility, water, biodiversity management, etc.) from the public and private sectors, and universities and their campuses. This model needs to be usable and operable in environments that require robust governance mechanisms and intersectoral collaboration to solve technological, social and regulatory innovation challenges.
- Design a model that is ("more") *open* to the resolution of challenges launched by representatives of the public or private sector, paying special attention to challenges related to heterogeneous networks in favour of the profitability of the Living Lab itself and support for exponential growth and impact of business initiatives validated in these open innovation environments.
- Design a *transferable model*, meaning one with the capacity for intersectoral and Cross-ecosystem integration between Living Labs from the public and private sectors, paying special attention to monitoring replication actions and implementation of innovations between universities in different countries.

Regarding these requirements, the research for the design of the model was based on an arduous review of existing models. The result allows supporting the ENoLL model with five tools that will be explained in the following sections of this document: *Governance Model, CoLabs Model, Impact Methodology,*

Cross-ecosystem Methodology and *Regulatory Sandbox*. The incorporation of these tools in the 4-helix approach does not eliminate the possibility of continuing to expand new sources of support that allow for more benefits of the Living Labs of the future.

To describe this model, this document is divided into seven sections. The first explains the context of innovation within the framework of the Ecological Transition and the Living Labs. The second section describes the model that has been designed. In the following five sections, there are detailed explanations of the tools that make up this model.

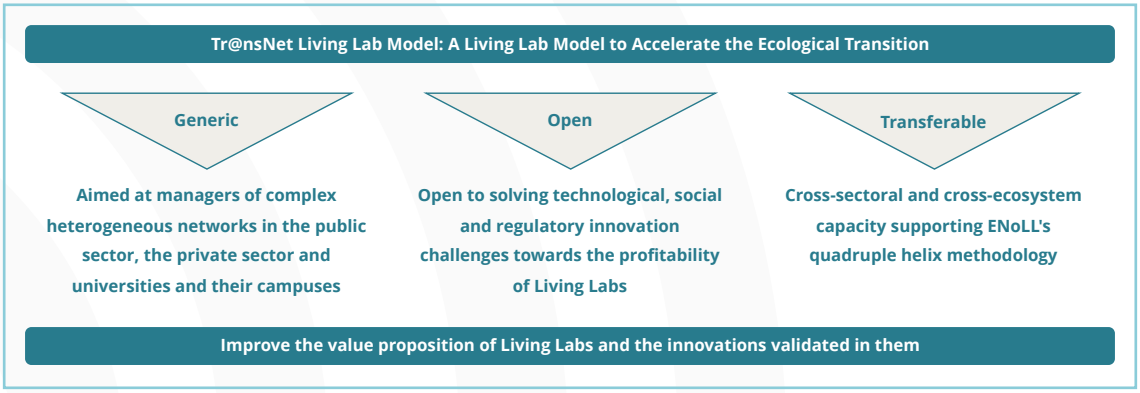

Figure 4: Key points in the design of the Tr@nsnet Living Lab Model.

2 TR@NSNET LIVING LAB MODEL

Joan Batalla-Bejerano and Manuel Villa-Arrieta, Funseam

The model proposed by Tr@nsnet is a set of five tools to support the 4-helix approach to innovation in the Living Labs validation of initiatives aimed at the Ecological Transition (see Figure 5). These tools are:

1. A Governance Model to design a clear commitment among the stakeholders of the innovative process of the Living Labs.
2. The Lab of Labs model, CoLabs, to design a new generation of Living Labs structured as territorial organizations, which are highly innovative and centred on universities.
3. An Impact Methodology to enhance the positive social and environmental impact and the exponential growth in the market of the initiatives validated in the Living Labs.
4. A Cross-ecosystem Methodology to help validate the way innovations work in different national innovation ecosystems.
5. A Regulatory Sandbox to help overcome both the regulatory gaps that technological innovations have, and the regulatory barriers that prevent innovations (new products or services) from reaching the market.

The integration of these tools into the 4-helix approach responds to five innovation challenges identified in the Tr@nsnet project:

- It solves the lack of integration of the Living Labs in the spaces or university campuses and the lack of governance mechanisms between the interested parties.
- It makes it possible to overcome the difficulties that regulatory innovation has to keep up with the growth rate of technological and social innovation.
- It allows for the promotion of disruptive innovations with exponential growth and positive global impact in line with the global requirement of sustainable development.

- It allows for the monitoring of the progress with regard to replication processes and the creation of technological demonstrators in heterogeneous networks.
- It means that collaboration networks between regional innovative agents around the universities can be established.

The first two tools, Governance Model and CoLabs Model, are models that help improve the value proposition of Living Labs in the market. On the other hand, Impact Methodology, Cross-ecosystem Methodology and Regulatory Sandboxes are methodologies that help improve the value proposition of the initiatives validated in the Living Labs. Thus, in addition to the six characteristics of the 4-helix approach, there are new ones that have been added: A clear commitment between the participants, integration of different types of

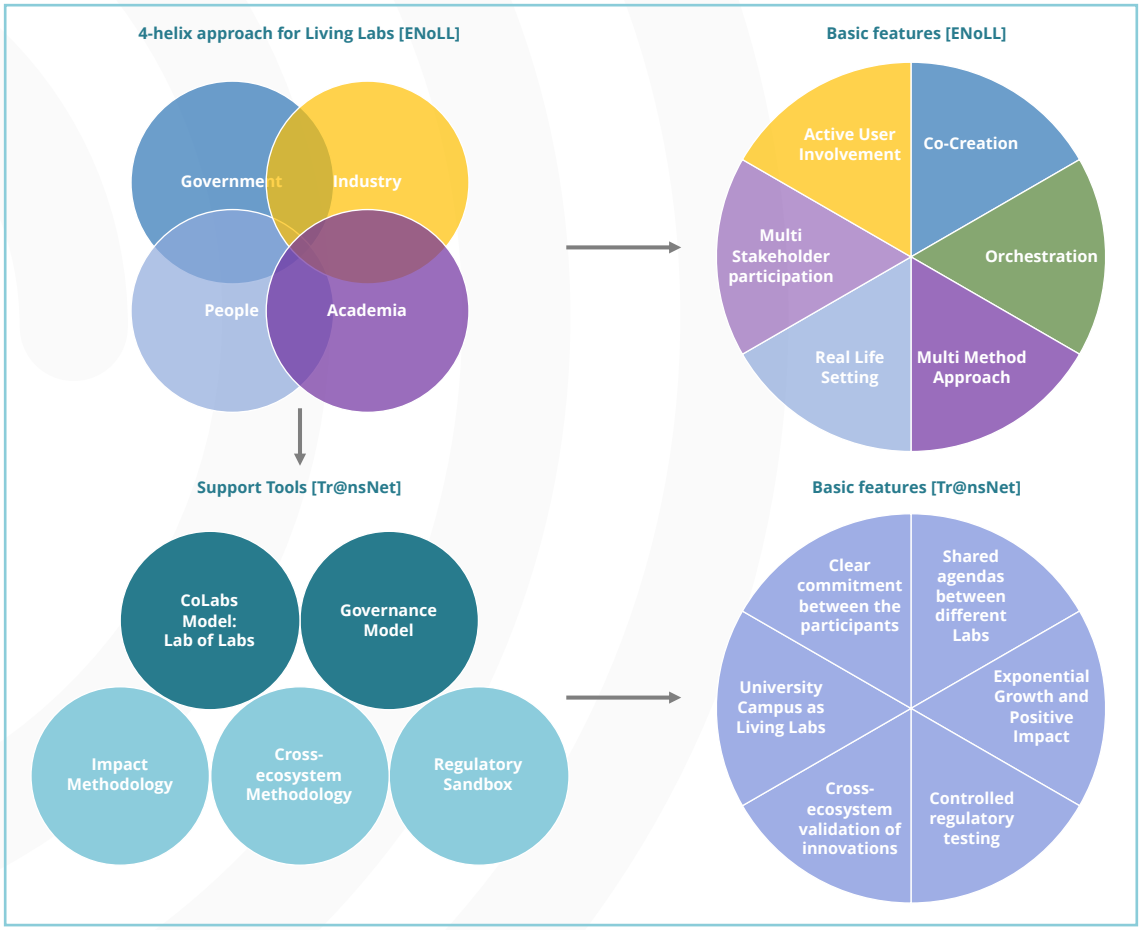

Figure 5: Support tools for the 4-helix approach proposed by Tr@nsnet.

labs, exponential growth and positive impact, controlled regulatory testing, Cross-ecosystem validation of innovations, the university Campus as Living Labs (see Figure 6).

Following an overview explanation of each of the model's tools, we go on to describe how they can be configured in the creation of Living Labs which are capable of facing up to the challenges of innovation in the Ecological Transition.

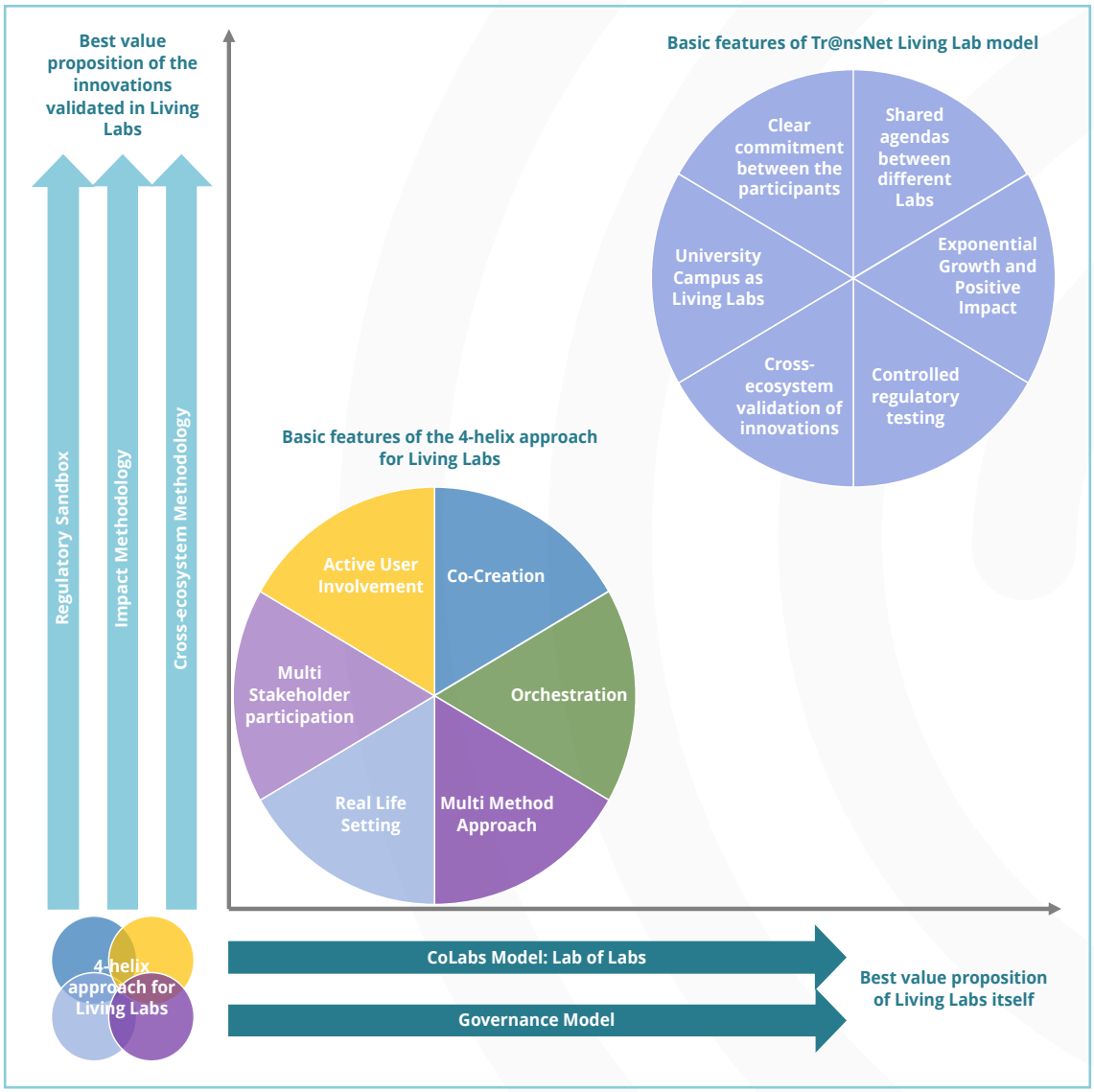

Figure 6: Tr@nsnet Model: Improvement of the Living Labs value proposition to improve the value proposition of the innovations validated in Living Labs.

2.1 Tools to support the quadruple helix approach

2.1.1 Governance model

Participants: Public and Private Sector, Academy and Society (represented by consumer associations).
What it is: This is a model that makes it possible to design a clear commitment between the participants in a quadruple helix innovation process based on a co-creation framework in the Living Labs. The model also makes it possible to establish a common objective among the participants, the specific presence of the representatives of the participating entities, the decision-making and communication mechanisms, clarify the benefits sought by the participants and their contributions in economic resources, equipment or personnel to the innovative process.
Why: Because in order to advance in the Ecological Transition, it is necessary to have innovative processes in the Living Labs that have clear and concrete conditions and commitments among the participants. In this way, the innovative process is enriched by a management of resources, actions and benefits obtained with a high level of effectiveness and efficiency.
How: Opening up the innovative process by defining the conditions for action

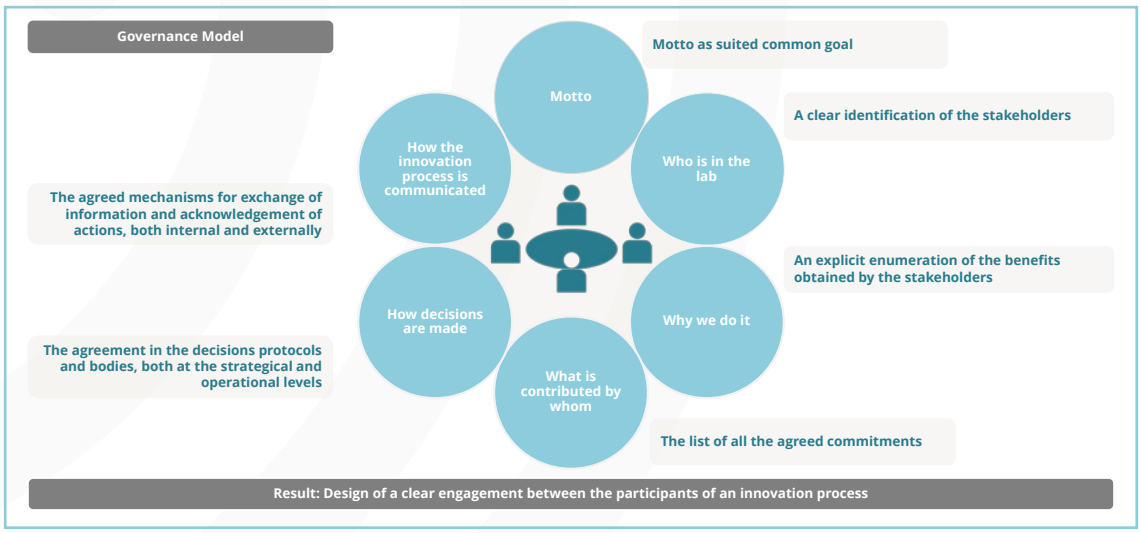

Figure 7: General outline of the Governance action framework. Source: Own elaboration based on Section 3.

from the beginning. This allows any representative of society to pose innovation challenges to all interested parties, but under a mechanism in which the innovation resources, processes and results sought reflect clarity and specificity.
Tools: The Governance Canvas Model is a base document for commitments and a point of reference for editing official agreements and monitoring procedures, as well as the definition of iterations to address transitions systematically. This document can be applied in many situations as it is not constrained to a specific implementation of the Living Lab's legal form and obtaining funding.

2.1.2 CoLabs model: Lab of Labs

Participants: Different types of Living Labs.
What it is: Collaboratories are labs of labs: universal innovation systems that encompass the set of people and territories digitally organized in order to resolve the green, digital and social transition in a coordinated manner. This model allows current Living Labs to expand their orchestration role by including other innovative initiatives in a territory (fablabs, social innovation labs, digital innovation hubs, clusters, etc.) and guide them towards solving common challenges.
Why: Because the Ecological Transition is a common problem. Its solution requires moving towards innovation systems that are different from the current ones in that they need to be more open and inclusive. This transition is connected to the digital and social transitions, which also affect society as a whole. Collaboratories make it possible to generate territorial networks between the different agents of innovation and around the universities, which means that this mobilization can respond to common challenges.
How: It is a process of social and digital innovation which starts from integrating local innovation entities ("Km0 I+D") with regional, national and supranational innovation systems, creating true universal systems of innovation. This union of systems makes it possible to generate a new persistent social structure, one with a digital base and that is open to the population as a whole for the innovative resolution of common challenges.
Tools: The Collaboratory Innovation Canvas, an adaptation of the business

canvas to define the Value Proposition of a collaboratory. “Collaborative Innovation Projects”, which are oriented to missions. Digital social innovation methodologies and tools of the Transformative Innovation Policy Consortium such as “shared agendas”.

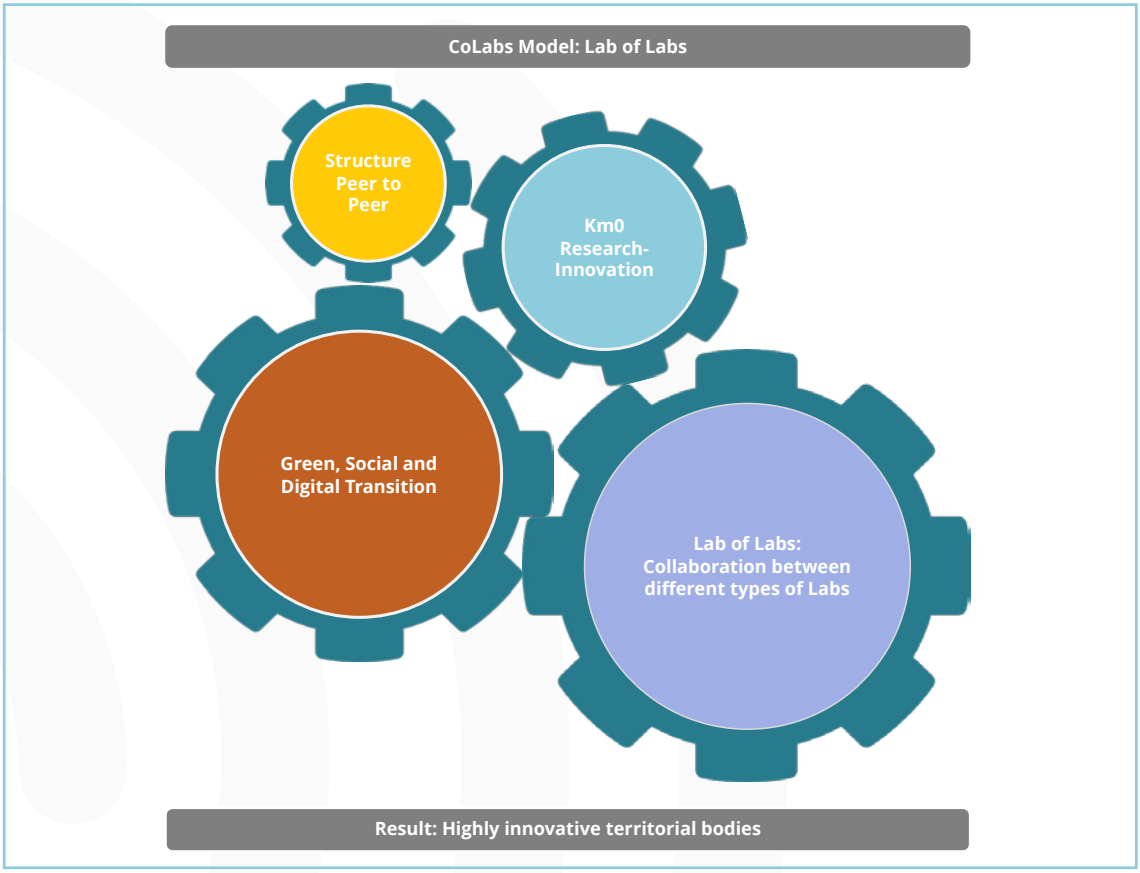

Figure 8: Overall view of the CoLab action framework. Source: Own elaboration based on Section 4.

2.1.3 Impact methodology

Participants: Innovators such as established companies, start-ups or public sector entities.
What it is: This is a framework for action that allows innovators to generate initiatives with a large positive impact and exponential growth in the market. “Initiatives” refers to new products or services or new business models. This framework allows innovators to align their creations or value propositions to the resolution of current social and environmental challenges, but with a

global vision through the optimal use of exponential technologies and innovation methodologies.

Why: To advance in the Ecological Transition, it is necessary to push forward in the innovation race by promoting inventions, projects and value propositions at any TRL or SRL level, and overcome the difficulty of promoting the growth of disruptive innovations.

How: By taking advantage of the democratization of technologies to promote the growing social awareness that cares and is dedicated to solving the social and environmental challenges we face. Thanks to these technologies we can count on new, more scalable organizational models, such as Exponential Organizations and Purpose Oriented Ecosystems, which, in turn, can achieve a massive positive impact in a short time.

Tools: Frameworks such as *Purpose Launchpad*, which focus on helping us integrate and put in order the different existing innovation methodologies to take them a step further. In this way, it is possible to integrate them into the processes of generating initiatives in Living Labs, including those which exist in university environments, and operate with the right mentality to create a positive impact in our projects and in the world. This tool helps to manage the six implications of the environment (6D) on which it is possible to grow exponentially with the interaction of an ecosystem which aims to have a positive impact.

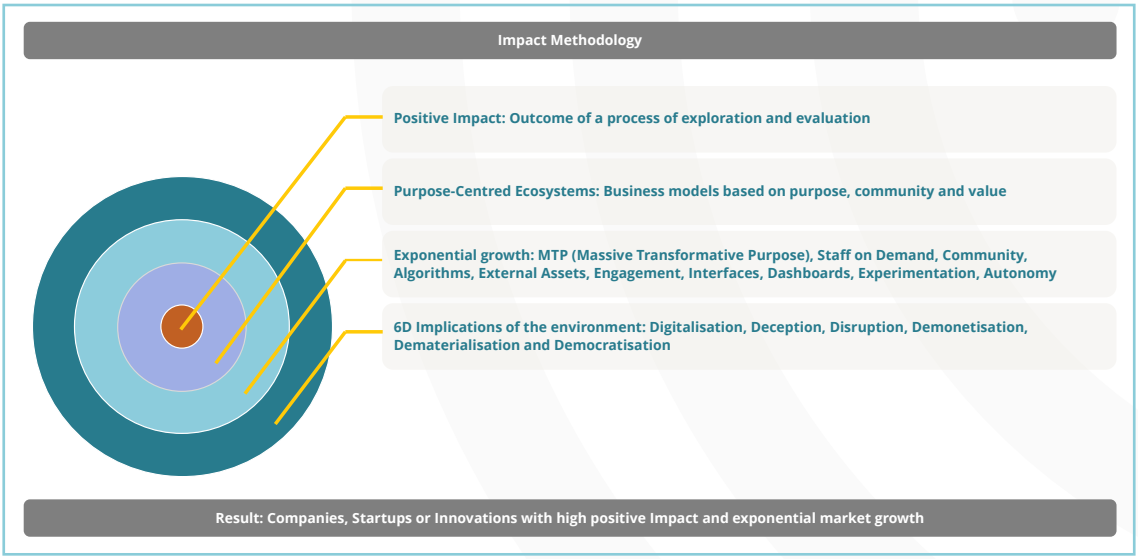

Figure 9: Overall view of the Impact action framework. Source: Own elaboration based on Section 5.

2.1.4 Cross-ecosystem methodology

Participants: Living Labs or public or private innovative entities.
What it is: It is a methodology to validate the operation of innovations in different national innovation ecosystems.
Why: Because in order to advance in the Ecological Transition, it is necessary to have a framework for monitoring the processes of innovation replication in existing technology demonstrators in different regions or countries. Similarly, a monitoring framework for the creation of new technology demonstrators is needed. It is also necessary to consider the validation of the different components of a Living Lab (both technical and in terms of interaction between participants and the user) as well as administrative and regulatory components in different ecosystems from different regions and countries, thus enabling joint and collaborative validation.
How: By connecting the innovation ecosystems of each Living Lab based on how the characteristics of each one complements the other. This includes the resources in the demo environment (Living Lab, Testbeds, etc.) and those of the ecosystem (cultural background, regulation, market, conditions climatic and geographical, etc.).
Tools: Cross-ecosystem Innovation Canvas, a key document to facilitate collaborative innovation between different ecosystems and deal with difficulties

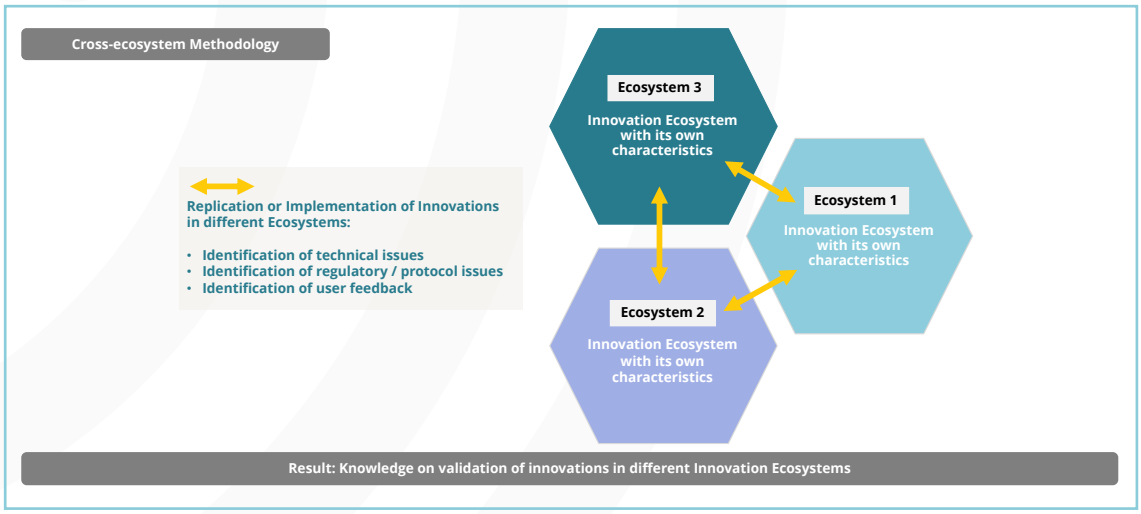

Figure 10: Overview of the Cross-ecosystem action framework. Source: Own elaboration based on Section 6.

that may arise along the way. This methodology is based on the characterization of three components: Identification of technical issues, Identification of regulatory and/or protocol issues, and Identification of user engagement difficulties. The methodology is based on the iteration of the replication of solutions to overcome the problems that have been identified. The final aim is to know how the innovations behave in the different validated ecosystems in order to reduce the risks of entering the international market in the process of natural scalability of the same.

2.1.5 Regulatory sandbox

Participants: Regulatory entities (Regulators) and innovative entities (Innovators) in the public or private sector.
What it is: This tool allows Regulators to overcome regulatory gaps with technological innovations, and Innovators to overcome regulatory barriers that prevent their innovations (new products or services) from entering the market. The resulting product is firstly regulatory innovation or regulatory learning and secondly technological and social innovation.
Why: Because in order to make advances in the Ecological Transition, it is necessary for regulatory entities to have a regulatory environment that is in harmony with the processes of technological and social innovation. This prevents Innovators from encountering regulatory barriers that prevent them from bringing new and better products or services to consumers.
How: By carrying out innovation processes in which both Regulators and Innovators can participate in the design, development and deployment stages of innovations through experimentation. For this, the Regulators must establish scenarios with geographical and temporal limits in which provisional regulations can be studied or specific regulations can be made more flexible. The priority of this framework is for Regulators to obtain regulatory innovation to allow all innovators, and not just the Innovator participating in the experimentation, to benefit from stable, harmonious and non-discriminatory regulation.
Tools: Regulatory Sandboxes, which are validation environments for regulatory innovation in experimentation processes with technological and social

innovations. These tools help validate innovations from a multisectoral and multidisciplinary scope, simplifying administrative procedures and protecting innovators and consumer interests. Sandboxes can be integrated into Living Labs as an environment for regulatory experimentation.

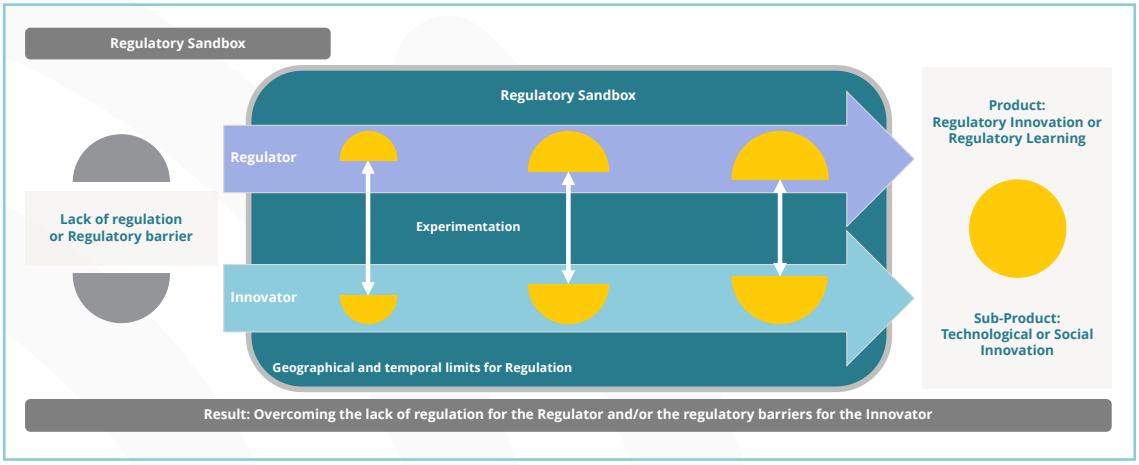

Figure 11: Overview of the Regulatory Sandbox action framework. Source: Own elaboration based on Section 7.

2.2 Integration of Tr@nsnet Living Lab Model tools

As explained above, the Tr@nsnet model makes use of two types of tools: those that help improve the Living Labs' value proposition and those that affect the innovations validated in them. The integration of these tools in the context of Living Labs is an exercise to advance in the conjunction of technological, social and regulatory innovation processes. Each of these tools has its own scope of action outside this integration framework proposed in the Tr@nsnet project[3]. To integrate these two groups, we have defined a system that unifies the levels of maturity of the initiatives that will become technological, social or regulatory innovations. The objective is use the Governance Model and the CoLab Model to provide an effective reading of the process of creating value proposals in the innovations validated in these Living Labs by using the Impact and Cross-ecosystem methodologies and the Regulatory Sand-

3. [70] describes the specific characteristics of each experimental space, with which the application of test beds, living labs and regulatory sandboxes in innovation processes is differentiated.

box. This system is made up of the Technology Readiness Level (TRL) to read the process of technological innovation, the Commercial Readiness Level (CRL) to read the progress of the design of a potential business model, the Social Readiness Level (SRL) to read the social change achieved with technological progress, and the Regulatory Readiness Level (RRL), proposed in this model, to observe the process of regulatory innovation. Table 1 presents how these maturity levels relate to each other.

Table 1: Maturity levels of technological, social and regulatory innovations.

STAGE	LEVEL	TRL [4]	CRL	SRL [5]	RRL
Research	1	Basic principles observed	Idea	Concept with potential for systemic change	New regulatory concept or modification of an existing regulation
	2	Technology concept formulated	Intellectual Property (IP)		
	3	Experimental proof of concept	Roadmap	Proof of concept with potential for systemic change	
Development	4	Technology validated in lab	Competitive Analysis	Socio-Technical system prototype. Demonstration of positive systemic change	The new or modified regulation creates a temporal and geographical validation scenario for technological and social innovations
	5	Technology validated in relevant environment	Ecosystem		
	6	Technology demonstrated in relevant environment	Business Model	Functional in good systemic change	
Deploy	7	System prototype demonstration in operational environment	Business Plan	Functional in good systemic change	The new regulation effectively regulates technological and social innovations
	8	System complete and qualified	Investment		
	9	Actual system proven in operational environment	Constitution / Sales	Integrates into normal practice within good life & society systems	

Source: Own elaboration adapted from [4] and [5].

With this system, which relates the reading between the different types of innovations, we can establish the following advantages for the tools of the Tr@nsnet model in the three phases of the innovation process: idea suggestion (Research), validation (Development) and release to market (Deployment):

- The CoLabs Model gives greater clarity to the projects shared between the different types of Labs.
- The Governance Model distributes the commitment and allocation of resources among the participating parties with greater segmentation and efficiency.
- The Impact methodology connects technological advancement with a global social and environmental purpose in its experimentation cycles.
- The Cross-ecosystem methodology traces the flow of feedback between the participating ecosystems with the highest segmentation throughout the entire innovation process.
- The Regulatory Sandbox effectively connects the advancement of technological and regulatory innovation and establishes a clear sequence in the regulatory learning processes.

Thanks to this unified system that specifies the maturity levels of innovation, we can identify two sections within the Living Lab's operation and describe how the tools are integrated into the proposed model. Figure 12 exemplifies this idea in the operation of a University Living Lab (ULL). First, a frame highlights (in blue colour) the context of action of the ULL in which the four helices of the 4-helix approach (Government, Industry, Academia and People) interact. In this space, we have also placed Living Labs with other value propositions. Within this framework we can find the Living Lab interacting with the environment through digitization and ecological transition. The upper section of the Living Lab is in charge of managing its value proposition, and this is where the Governance Model and CoLabs tools are located. The lower section manages the innovation process of each initiative, project or challenge addressed by the Living Lab and this is where the Impact Methodology, Cross-ecosystem and Regulatory Sandbox tools are located. The intercon-

nections between these tools and the components of the 4-helix approach are made through Inputs, Processes and Outputs which are described below.

Inputs in the model

Two types of Inputs connect the interaction of the Living Lab with its environment: the Inputs/Outputs between the ULL and other Living Labs within the management of the CoLab Model, and the Input from the interaction of the ULL with the Industry, Government and Society through the Governance Model, without going through the management of the CoLab Model. Using the CoLab Model, the ULL establishes a two-way connection of collaborations based on "shared agendas", which help promote territorial innovation based on the ecological and digital transition. Running concurrently to this, the Governance Model delimits the commercial management border of the ULL through Inputs with the market (companies or public sector) and offers projects and initiatives that feeds resources into the Living Lab.

Based on the Governance Model, the Resource Inputs that feed the innovation process in the Research, Development and Deployment phases are managed. In a segmented innovation process through the TRL, SRL, CRL and RRL maturity levels, the necessary resources for the innovation process are defined. These are: multi-sector integration, commitments, intellectual property, human and physical resources or communication, among others. This relationship between open innovation and the levels of maturity of the innovations allows the Living Lab to be clear about its economic sustainability and the growth potential in the market of its value proposition, a proposal that is based on its ability to promote innovations that have already been validated in technological, social and regulatory monitoring environments through the Impact Methodology, Cross-ecosystem Methodology and Regulatory Sandbox tools.

Innovation process in the model

In the lower section of the graphic description of the model, we see the tools to improve the value proposition of innovations. Here the processes of exploration, experimentation, performance measurement, iterative engage-

ment with people and the preparation of results are carried out. In the first instance, the Impact Methodology helps at all levels of growth of the initiatives, to deliver to the market technological and/or social innovations with a positive impact. Underneath this, the Cross-ecosystem Methodology helps to validate innovations through replication experiences in other ecosystems (other Living Labs within the CoLab Model, or technology demonstrators from public or private agents, among others). With the use of the Governance Model and the study of the impact of innovations through the Impact Methodology, it would be possible to use the Cross-ecosystem Methodology to also study the performance of innovations in different ecosystems and thus achieve a better value proposition to the market.

The Cross-ecosystem Methodology can begin to be used in the seed phase of innovation in R&D processes. In this case, the Governance Model should serve as a meeting point for the responsibilities and resources of the participants in each ecosystem. Likewise, the Impact Methodology can be included in order to study, in its exploration and evaluation sequence, the different conditions of each ecosystem integrated in the Cross-ecosystem Methodology. Finally, as a tool to overcome the absence of regulation and/or regulatory barriers, the Regulatory Sandbox offers a configuration at any level of maturity of the initiative, but mainly in the final TRL and SLR stages, since this tool prioritizes the regulatory validation when the technology is mature. However, the study of regulatory innovation can also participate in a very low stage of initiative maturity. In these cases, the regulatory innovation process is clearly based on regulatory learning from initiatives with a high potential for disruption.

Outputs of the model

Like the Inputs, the model has two types of Outputs: those that connect the end of the innovation process with the value creation tools, and those that connect the innovations with their environment. In the former, the most basic level of Outputs is obtained with the Impact Methodology tool. With this methodology, innovations are promoted with a global social and environmental vision and initiatives can be received in any of the three stages of

the innovation process, depending on the results of the ULL governance management. Then we identify the results of the replication of innovations with the Cross-ecosystem methodology, which can be connected in an iterative process with the Impact Methodology. Subsequently, we find regulatory innovation as the Output of the Regulatory Sandbox, which can connect with the validation of innovations in other ecosystems, through the Cross-ecosystem Methodology, and with the validation of the technological or social part of innovation, through the Impact Methodology. Finally, we find the Outputs that come out of the Living Lab and that bring the innovations to the market, either through the projects or agreements managed in the Governance Model or through collaboration with other Living Labs in the management of the CoLab that came to exist.

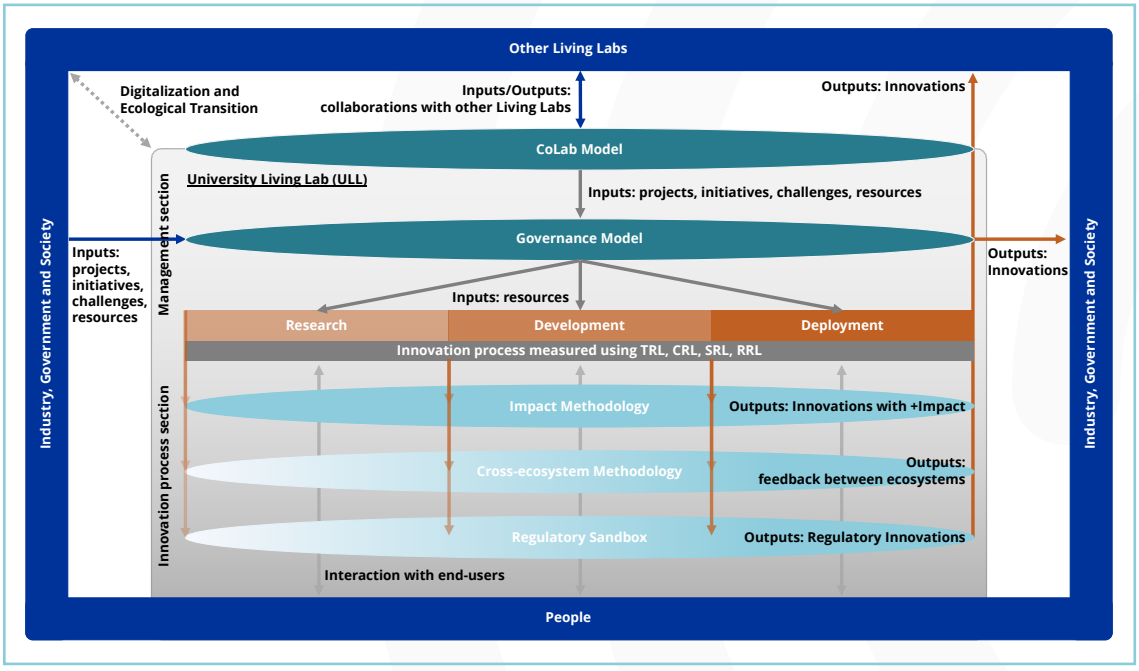

Figure 12: Tr@nsnet University Living Lab Model.

3 GOVERNANCE MODEL
Governance models for Living Labs
Fernando Vilariño, Computer Vision Centre (CVC) - UAB

3.1 The challenge of governance

3.1.1 Understanding the context of the Digital Transformation

The context of the modern Living Lab approach is provided by the Digital Transformation, which in the specific European scenario is stated as a twin Green and Digital Transformation [6].

The Green part of this twin transformation aims to have a more sustainable approach to the use of natural resources, and it has been triggered under scientific evidence showing human impact on the climate at a global scale, substantively associated with fossil greenhouse gas emissions. The Digital part is strongly related to the impact that the development of the Internet is having on the economy and our way of life, and it is usually referred to as profound revolution.

But the Digital Transformation is not only a new industrial revolution: It is an actual human transformation. The connectivity that internet provides gives everyone potential access to all the available human knowledge. It is clear, to our knowledge, that this potentiality has not yet been fully deployed, and that its consequences bring profound ethical issues to our table. The Digital Transformation will radically lower the social entry cost for accessing and generating knowledge, thus creating a real opportunity for the personal and collective development of people. At the same time, new areas of expertise and jobs will emerge and disappear, the interdisciplinary boundaries will blur, stakeholders' borders will fade, and this will ultimately trigger profound transformations in the ways that citizens live their lives. This will happen at a pace never previously experienced and, in this context, an agile response from the public institutions, legal and informal entities is indispensable.

This approach was brought together in the Manifesto for Innovation in Europe [7], coordinated by the European Network of Living Labs[4] and like-minded organisations. The Manifesto presents a vision of Europe that is open to the world, with the consolidation of ecosystems in which citizens are not only beneficiaries of growth but are also co-creators and co-owners of the resulting societal changes, actors shaping the progress towards a Europe of citizens. The Mazzucatto report [8] pointed towards this direction in the context of an open innovation framework in which this idea is addressed through common missions, and in some way, it deploys the previous approach to the entrepreneurial state [9] as a driver for innovation, particularly in the European context. During the Open Living Lab Days Conference in Geneva in 2018, the Under-Secretary General of United Nations Michael Moeller shared that "the challenges we face cannot be tackled by one institution alone"[5]. I cannot agree more, and this compulsory approach to problem solving –and enormous area of opportunities, too– requires an agile response from the institutions. It is in this context that the multi-stakeholder approach provided the Living Labs makes sense from a user centric-perspective, from a citizen-centric perspective, and from a human perspective.

The corollary that arises from this rationale could be stated thus: In the context of the Digital Transformation, innovation and social transformation are happening hand in hand, and we need to broaden the definition of innovation beyond the current, predominantly scientific and corporate approach. Placing the citizen at the centre of innovation is a real game-changer and an opportunity for innovation-led economic growth and social progress. On our path to strengthening our society, this is an efficient way to ensure that no one is left behind. This societal transformation is systemic in essence. It is materializing in The Lab as a social technology, it is running on Collaboratory principles (both from the collaboration and lab), and it opens the opportunity to the world with this message: all citizens in the world, organizations and networks are invited to be co-creators of the global societal transformations to come.

4. European Network of Living Labs (ENoLL). https://enoll.org/
5. Open Living Lab Days. https://openlivinglabdays.com/past-editions/

Technology has been and will continue to be the enabler of the Digital Transformation. But in order for our Hard Technologies to succeed as useful instruments for the co-creation of the Digital Society, it is essential to have a strong substrate of Social Technologies that serve as the foundation for sustainable, robust and democratic access to knowledge and innovation [10]. Living Labs emerge as a relevant component of these social technologies. In the sections below, we will focus on how Living Labs can support this view.

3.1.2 The Living Lab as citizen-centric multi-stakeholder approach to innovation

Living Labs are about innovation

The innovation process is the essential and necessary, albeit not sufficient by itself, element of all Living Labs. As previously discussed (see Figure 5), the ENoLL approach to Living Labs, which has successfully spread throughout the world over the past 14 years, is synthesized through a citizen-centric multi-stakeholder approach to innovation, which is based on systematic user co-creation that integrates research and innovation activities in communities.

All Living Labs share basic features, that are strictly linked to the user-centric multi-stakeholder approach. These features can be summarized as follows: Active user engagement within a real-life setting, in a co-creation process with multi-stakeholder participation and multi-method approach. Certainly, a role of orchestrator, of coordinator of the multi-stakeholder user-centric co-creation process in the real-life setting is necessary, not only from a project management perspective, but also as a bridge for methodological multiplicity. In fact, this can also be viewed as the much-needed actor for translation process for the different languages (in the sense of epistemological background) spoken by the stakeholders.

The framework presented in Figure 5 provides a rich variability of options for Living Labs, which usually have an instigator institution or body driving the

Living Lab project. For a survey on Living Lab methods and tools, the interested reader can consult [11]. For clear examples of Living Lab projects, the reader can consult the annual summaries of "Best Living Lab Projects" edited by ENoLL every year [12]. For a deeper analysis on the emergence of Living Labs and a starting point for a further literature review, I would recommend the paper by [13].

The multi-stakeholder and multiple-helix approach

The multi-stakeholder approach can be explained using the metaphor of the quadruple helix [2]. The quadruple helix concept extends the approach of the triple helix [14], which emphasizes hybrid collaboration between academia, industry and government to provide enabling scenarios for innovation and economic development. The helix plays the role of the propellor of innovation-led growth and each blade represents one necessary component –type of stakeholder– for the innovation process to take place successfully. The fourth component of the quadruple helix is "People", representing the active participation of civil society in the process. From this perspective, the term "People" is usually replaced by "Society", "Civil Society" or "Citizens". In any case, this represents the clear intention of having the citizens (individuals, associations, non-for profits, etc.) participating in the co-creation process as actors, and not as mere factors from which to obtain ideas or raw data. The quadruple helix is usually extended to multi-helix approaches, including elements of sustainable territorial development [15].

User-centric, citizen-centric and human-centric innovation

The process of the definition of new products and services through the active implication of the users in the real-life settings is a key feature of the living lab approach. It is based on the foundations of user-centric design and its benefits over manufacturer-centric innovation are well-known: Users that innovate can develop exactly what they expect to, rather than relying on manufacturers to act as their (often very imperfect) agents [16]. The trend toward the expansion of the set of agents enable to innovate (the democratization of innovation) has found its main field of development in information products

such as software, but also to physical products and general services. This approach responds to the paradigm of user-centric innovation, in which people outside the organization driving the innovation process will participate in the definition of the final product or service by contributing with their own view in terms of product needs. It is relevant to highlight that, as described above, this is process of delegation: the institution delegates part of the process in people outside the organization, which accepts the contribution under the role of "user", expecting benefits.

The word "role" is also key here. The approach will evolve from user-centric innovation to citizen-centric innovation when the user is viewed as part of the Community. Here, being a citizen does not have to be understood from the reductive context of the city, which directly pushes us to think on the Smart City as paradigm of innovation, but from the more general of "citizenship". The role of the citizen is no longer being constrained to being a user of a novel product, but rather this user is member of a social community, with social norms and specific regulations, with changing habits.

As mentioned above, the Digital Transformation provides the room for a human transformation, and this also affects specific dimensions of the citizen-centric innovation, particularly those related to ethical issues, inclusion and representativity, the digital gap, and others. The human-centric innovation approach goes beyond the political subject of the citizen and tackles the human being as the focus of positive social transformation: users of products and services, members of communities, in full human dignity.

3.1.3. Challenges and opportunities in the context of the Campus as a Living Lab

Empowering everyone to innovate, leaving no one behind, is clear as a beacon for the Living Lab community. But if this challenge is to be tackled effectively, it will be mandatory to understand the new dynamics involved in the governance of a 4-helix initiative. These dynamics must go beyond simple decision-making schemes, so Living Labs will need a solid foundation to en-

able stakeholders to develop an environment of trust to carry out citizen-centred innovation activities. This is an iterative process, which needs clear alignment with internal priorities and clear commitments to ensure that impactful actions take place.

The general challenges described in Section 1 have their own particularities when brought into the context of the university campus as a Living Lab. These particularities are linked to the missions that University is holding historically: knowledge generation throughout the research activities, capacity building through the learning programs, and social impact through the process of knowledge and technology transfer.

Universities have historically enjoined a certain level of autonomy, with specific governing boards a governance. University campuses are of different nature, and they can be embedded in the urban area or being constraint to their own territory, but in all the cases, they share the same governance framework, independently of the geographical distribution of the different facilities. In the latter case of a campus constraint to its own territory, we are facing an actual city, with its own systems for waste management, energy generation, mobility strategy, security bodies, etc.

At an administrative level, even though universities belong to a specific municipality, they tend to be severed to a certain extent from the actual municipality services; in some way they can be perceived as Vatican Cities within their own municipalities, their Provosts or Presidents receiving the social perception of an elected mayor. This affords them with a great deal of flexibility for decision-making, since the internal organization of the university is not linked to the municipal political decisions. At a regional level, the university can act as a de-facto city, the real-life setting of the Living Lab.

In this city, citizens can be stratified in four different layers, namely: students, teachers, researchers, and support and administrative services. All these citizens have their own missions (role) and objectives around the activities of research, teaching and knowledge transfer.

Innovation is a transversal action in university campuses, and it is not only expected for the knowledge transfer dimension from research to new products and services, throughout the creation of spin-offs, start-ups, licensing and patents. Researchers are acknowledged for their technology transfer capacity, and they have specific incentives if they succeed in it. Innovation is also a key component for teaching, and university teachers are acknowledged with benefits such as wage increases if they successfully accredit a record in teaching-innovation activities, which are in many times linked to new technological developments allowing for novel methodological approaches.

The presence of companies in the university campuses, particularly in the public university, is controversial, since it could be perceived as a privatization of the public service, and private sponsoring or private interventions in the university has to be approved by different bodies[6]. On the other hand, it is precisely thanks to the transversal component of innovation impregnating all the campus activities that the presence of the economic actors can boost new products, services and processes, to be translated to city and society. In some way, it responds well to the test-before-invest approach, in a pre-commercial stage, within a community that is already used to the innovation dimension, and that could be perceived as a community of early adopters of innovations.

For all the forementioned reasons, when approached as a Living Lab, any potential Governance Model within the university campus must not only be fully compatible with the activities taking place in the universities, but it must act as an enabler and booster for all of them. Only when the campus as a living lab is fostering research, and it is integrated in the teaching programs, and it is providing a powerful tool for technology transfer to society, would it be possible to articulate a sustainable Governance Model. In the following paragraphs we will present a general methodological framework and tool which is fully compatible with this approach.

6. For the specific case of the Spanish universities, the Social Council has the competence of supervising the economic activities of the University, the performance of its services and of promoting the collaboration of society in financing the university [67].

3.2 Defining the governance model for Living Labs

In this section we will provide a practical approach to the definition of the Governance Model. This implies the need of efficient tools than can be accepted and understood –from a methodological point of view– from all the stakeholders. As mentioned above, one specific stakeholder can usually play the role of *instigator* of the 4-helix initiative, but this instigation cannot be misunderstood as a one-partner initiative to which the rest are invited to contribute at zero risk, if an actual co-creation project is expected.

Defining the solid base for a Governance Model on a Living Lab approach implies a clear definition of the following dimensions:

- A suited common goal (*Motto*).
- A clear identification of the stakeholders (*Who is in the lab*).
- An explicit enumeration of the benefits obtained by the stakeholders (*Why we do it*).
- The list of all the agreed commitments (*What is contributed by whom*).
- The agreement in the decisions protocols and bodies, both at the strategical and operational levels (*How decisions are made*).
- The agreed mechanisms for exchange of information and acknowledgement of actions, both internal and externally (*How the innovation process is communicated*).

At the light of the proposed task, the first question that arises is: Where do we start from? In order to respond to this question, and to facilitate the process of design and analysis of the Governance Model in a systematic way, the Governance Model Canvas [17] has been proposed as an efficient tool in the context of the Capacity Building Program of the European Network of Living Labs. The tool has been the basis of the Governance Models Module of the Virtual Learning Lab training course[7], and it has helped more than 300 trainees in 6 editions of the program to define their approaches to real-life initiatives.

7. ENoLL Virtual Learning Lab. https://openlivinglabdays.com/virtual-learning-lab/

The Governance Model Canvas provides an easy-to-use tool, with clear paths, that allows a constructive approach to a feasible model, forcing the right questions to be asked, and avoiding non-realistic approaches to sustainability. Figure 13 shows a representation of the canvas, in which all the dimensions identified above are included. The canvas aimed at being filled in a constructive approach: A number is associated to every title, indicating the sequential order for the discussion of items. In the following paragraphs, we will discuss in detail what is expected to be included in every section and why.

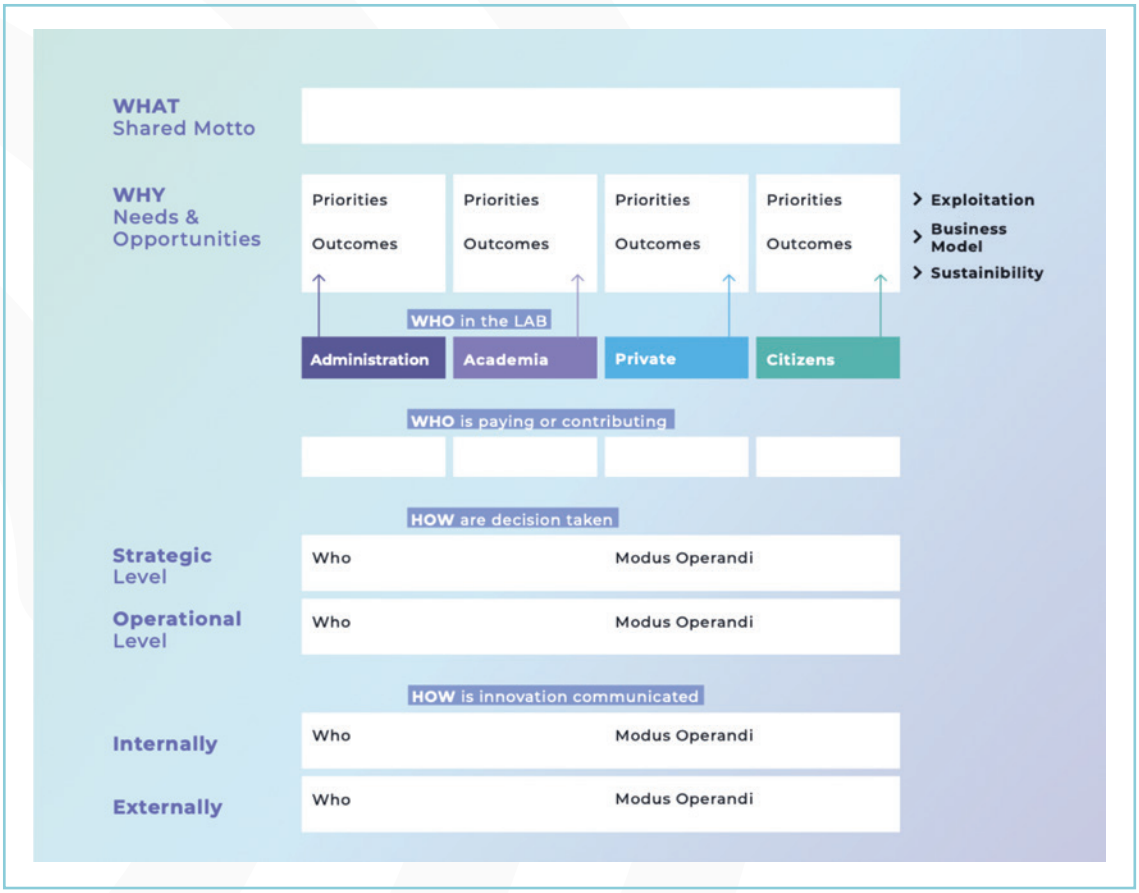

Figure 13: The Governance Model Canvas. Source: [17]

3.2.1 The motto as suited common goal

A suited common goal has to represent a mission which is acceptable for all the partners involved in a synthetic way. It should include relevant keywords related to the Living Lab, contextualizing its specific activities. However, the

motto is not just a collection of relevant keywords, but it conveys a proper meaning also in its syntactic form by identifying the strong points or added value that the Living Lab initiative is providing, i.e.: at a nominal level, which ambitions are being aimed at or who the target of the actions is; and at a predicative level, how things are done. Usually, and referencing its etymological roots in Latin, the motto starts with a verb identifying the action (the motion, the transformation provided to the ecosystem) and refers to the "who" and/or the "how" as the added value obtained from the 4-helix approach. This can be implemented in different ways, although, as a rule of thumb, the motto can consist of an acronym (namely, the name of the Living Lab), a title developing the acronym, and a subtitle providing specific detail.

The motto has the number 0 within the order of the steps to be taken, since it is something that has to be discussed by the stakeholders at the very beginning of the definition of the Governance Model. All the ambition of the initiative will be distilled into the motto, and it will act as a lighthouse, a safe place to get back in case of doubt for the rest of the process.

This does not mean that once that the motto is set it cannot be changed. All the contrary, nothing in the canvas will be assumed as carved in stone, but as a flexible item to be revisited in an iterative way. However, it must be taken into consideration that, by changing the motto, the reference point of the whole model is moved accordingly, and all the previously agreed steps for the following points would need to be reviewed at the light of the new motto.

3.2.2 Who is in the lab

This section represents the participants distributed in the 4-helix (Public Administration, Academia, Private Sector and Citizens), and it is expected that a number of them have already taken part in defining the motto. For this part, the current partners are expected to identify all the stakeholders that will be needed in the governance of the Living Lab in order to make the Living Lab initiative sustainable. This would imply an internal discussion and agreement on who the potential new members are. This also implies an exercise which

carries a certain level of uncertainty, since those identified partners are not going to be (initially) in the discussion.

The potential inclusion of needed stakeholders represents a good example of the iterative nature of the design of the Governance Model, since once new needed partners are identified, they should be invited to the review and validation of the Governance Model that has been achieved. However, since it is common practice that in every Living Lab initiative there would be one partner that acts as the instigator of the initiative, it is also natural that the instigator would present an initial list of partners, setting up a starting point in terms of stakeholders and a primary version of the Governance Model based on those initial partners.

The different stakeholders must be defined with the highest precision (which municipality, which department, which office), since it would be strictly related to the commitments and personal involvement in the decision making. Eventually, when identifying a specific stakeholder, we usually have one or several specific persons (allies) with name and surname in mind. Even when this will very much help consolidate the model, it is not strictly necessary at this stage of the definition of the model.

On the contrary, what is definitely needed is a set of backing documents. These backing documents correspond to the strategic plans, mandates or missions of the different stakeholders in which it is explicitly written one section that tackles the ambition of the initiative. In other words, one municipality would be compelled to be part of Living Lab aiming at, to take an example, "Defining the new waste management service for all" if such a municipality has in its strategic planning for the following 3 years the development of innovative solutions for the waste management, and if this is the case, it will be written down in, let's say, page 10 of its current 4-year strategic plan. In addition, if inclusivity is one of the municipality's political priorities, then "for all" is something that they will be happy to address, since they were going to do it anyway. The big change when facing the involvement of the stakeholders in this way is that now our municipality has one powerful instrument to tackle

its two commitments, being the municipality explicitly identified as a challenge owner, and the contribution of specific commitments to the Living Lab initiative is fully justified with –political– legitimacy.

This same rationale can be applied to the missions of the research centers and universities, or to the concrete business and social responsibility objectives of the private sector, or even to the needs from the different associations of citizens and individuals. The key point can be summarized as follows: The stakeholders involved explicitly acknowledge the Living Lab as a tool to achieve a number of their specific strategic objectives.

3.2.3 Why we do it

At this point, we are in a position to enumerate the strategic objectives from all the stakeholders participating in the initiative. We can also identify the specific actions present in their binding documents, which refer to the concrete alignment of priorities with the motto. With this, it will be relatively straightforward to identify why every partner is in the Living Lab initiative, and this section substantiate this alignment by explicitly identifying the expected return that the initiative will provide to every stakeholder.

Beyond a shared common motto, every stakeholder will have their own reasons to be part of the initiative, and therefore it is very important to highlight that it is not the aim of this section to identify common or global returns in terms of societal impacts, focusing on specific returns for each partner at the individual level. For this reason, for every single stakeholder these returns must be identified in a single sentence based on needs and opportunities (again –not minor issue to remember!– aligned with the strategic documents). The returns obtained from the innovation actions can be of different nature: new business models, new services, the exploitation of a product, etc. All these returns provide key performance indicators for the level of achievement of the priorities identified. Even when the processes of open innovation can provide outcomes that are not planned, this can be easily agreed as the “expected unexpected”, and the task of pre-defining several

potential outcomes is still a good exercise and an efficient tool to advance impact assessment.

At this point of the process, we have a narrative of the "what", "who" and "why". The elements presented in Sections 0, 1 and 2 are the main ingredients of a mission statement for the Living Lab, complemented with the explicit identification of interests compatible with the strategic approach of every partner, and the concrete expectations of return that justify the involvement. The next Sections will focus on the "how".

3.2.4 What is contributed by whom

Commitment is key to ensure the Living Lab activities are carried out in a sustainable way. For this reason, it is essential to identify concrete commitments from all the stakeholders. These commitments are binding for the stakeholder, and they must be perceived as the building blocks which enable the operational level. As a general rule, the commitments can be distributed in 4 different types:

- **Financial:** This represents cash flows that come from the stakeholder's own budget and are dedicated to fund the operations of the Lab.
- **Personnel:** People, in terms of person-month contributions, that are associated with the lab activity. This does not necessarily imply people hired by the Living Lab[8]. It can be also personnel from the different institutions that dedicate a part of their monthly hours to tasks related to the Living Lab.
- **In-kind:** This can cover contributions such as the building, electricity, materials, products to validate, web and social channels, etc.
- **Representation:** This commitment accounts for the legitimacy and duty to represent the Living Lab in the different networks, conferences, meetings, etc.

8. It is relevant to notice here the impact described the Final Remarks section regarding a number of potential considerations related to the different types of juridic implementation that the Living Lab can have.

Certainly, all the 4 dimensions involve a financial commitment at the end of the day. For instance, a dedication of 3 person-month per year to the project has a concrete cost for the participant associated to the equivalent cost of the contract of the person (or persons). However, it is usually the case that for a number of technical and operational reason it is more feasible for the stakeholder to provide the initiative with person hours because cash flows are not internally allowed or would represent a more complex (or even not feasible at all) framework. Some partners would have more chance to contribute in-kind (for instance, a municipality being in the position to providing a physical space for the activities), and others would prefer to contribute with personnel (for instance, researchers associated to a publicly funded project). In any case, it is not compulsory that every partner should contribute to all the dimensions, but to take into account that the level and type of involvement will have actual impact in the ambition and, of course, in the outcomes and results.

Finally, the key point is to clearly identify the expected commitments quantitatively and qualitatively, understanding that if one single partner is breaking the commitment, the activities of the living lab, and its own returns, would be affected. This will be the bath of reality needed to decide if the initiative will be a go or no-go. For this reason, it would be a good practice to clearly identify a baseline of commitments for minimal activity, i.e., what is the minimum level of commitment needed in order to go forward. The baseline approach provides the minimum for the no-go, and it will be very useful to identify the minimum acceptable return expected.

3.2.5 How decisions are made

Decision-making is probably what first comes to mind when thinking of a Governance Model. Certainly, governing our cities or countries implies making decisions, and we expect our elected representatives to be good administrators for our common good and make wise decisions. However, at this point we already know that the Governance Model has to support the decision-making process with a solid foundation, and that an apparently good

decision-making scheme would have little impact if not everyone is rowing in the same direction, if the returns are lacking priority interest, and if there are no operational resources due to the lack of proper commitments.

As a matter of fact, it is the results from the previous sections which will allow for the discussions on a -suitable- decision making structure, solidly backed-up by the level of commitment and the different roles identified. We can divide this decision-making structure at two different levels:

- **At a strategic level:** This level contemplates the alignment of the political agendas to the activities of the Living Lab, ensuring that the opportunities and priorities identified in the "why" section are translated at an operational level. At this level, we expect a general review of the process, changes in strategic stakeholders or agreed commitments, or the halting of the activities. Even when the main aim is to review the reporting of activities and make decisions in terms of general framework, specific strategic actions can be discussed and agreed.
- **At an operational level:** This level contemplates the organisation and follow up of the day-by-day activities. It can consist of different sub levels, including a more direct operational committee and/or a monitoring committee, which could or could not report to the strategic level. In any case, the decision-making taking place aims at fulfilling and accomplishing the strategic objectives dictated by the strategic boards, by substantiating them in concrete actions with the right external actors.

  For both levels, every committee or board appointed will have to have a clear modus operandi, with a list of members with relevant roles from every institution, a time framework that allows for reasonable scheduling and commitment to the meetings, and a transparent decision-making mechanism for all the levels of decision. More in detail, the ingredients needed can be described as follows:
- **People:** Personnel with explicit internal roles in their different institutions (which will drive to a specific individual, with name and surname) for the different committees and boards.
- **Temporality:** This will be linked to the commitment of attending the meet-

ings. For the strategic level, usually one meeting either annually or every six months could be enough, since it is not expected that the global alignment of priorities with the political agendas would change rapidly. However, for the operational level, it would be good to have an agile process of assessment of activities, stakeholder mapping, identification of opportunities, etc.

- **Decision mechanism:** An explicit protocol for decision making will imply the identification of the partners with voice for every committee, the type of voting or consensus, the weight that every partner would have in the decision if voting is taken into consideration, etc. This must be transparent and fully acknowledged by all the stakeholders.

In terms of the baseline mentioned above, the decision-making mechanisms should contemplate the baseline or minimal operation scenario, defining a core-member group, which would allow, if needed, the future integration of other interesting stakeholders.

3.2.6 How the innovation process is communicated

Communication is usually the weak link in a 4-helix initiative, and the Living Lab approach intrinsically implies a multi-methodological approach to innovation. It is necessary to acknowledge that different epistemological fields are present for the varied stakeholders, and that this will be the source of a bottleneck in the communication. Again, it is necessary to acknowledge this, not as a relief in case of the ready-to-happen misunderstandings, but as a starting point to building upon it a robust mechanism allowing for efficient communication to happen. Thus, communication and communication acknowledgement must be understood as a (pro-)active task not parallel to but embedded into the Governance Model itself.

We can divide this task into two different levels:

- **Internal Communication:** In this level we account for the mechanism allowing to convey decisions and reporting from the strategic level to the operation level, and among the different committees. This goes beyond

the explicit informative reporting since it includes the acknowledgment for the implementation of the commitments.

- **External Communication:** In this level, we aim at ensuring a solid dissemination of actions in order to guarantee impact and visibility, but also channels so that interested new stakeholders can benefit from contributing to the Living Lab activities. In particular, it would be essential to guarantee sound mechanisms to integrate the vision of the citizens who want to be part of the initiative. From this perspective, external communication is not conceived as a unidirectional managing of the social networks, but as a genuine channel of interaction with the ecosystem.

We can replicate the structure proposed for the decision-making, by providing a clear modus operandi, with a list of members with relevant roles from every institution associated to the tasks. In addition to this, we will also include the explicit tools used for the reporting. This is relevant since it would imply the acceptance by the team members of a number of potentially new tools, to which they may or may not be used, and which may or may not be part of the institutional culture. Operational issues at this level are highly relevant and the wrong decision on the agreed mechanisms and tools could lead to communication bottlenecks. Communication bottlenecks are loaded guns pointing directly towards the flotation line of the initiative, and they should be taken into consideration at the same level as the highest decision-making structures.

Finally, we need to emphasize the need of accessible and transparent acknowledgement mechanisms. Communication actions are not an arrow in one direction, lost in a forest of email messages. Effective acknowledgment procedures ensure that all the stakeholders are on the same page. It is not enough to be updated in terms of information received, but it is relevant to be on the same page, this meaning that the shared information has been processed and, eventually, raised a follow-up action. A solid definition of an acknowledgement mechanism will, for instance, serve as a powerful tool for identification of new opportunities arriving from the different stakeholders, particularly those difficult to preview and with high added value.

3.3 The Canvas as an enabler

One of the advantages of the model defined through the Canvas is that it is not constrained to one specific implementation. Different types of Living Labs have different juridic forms: they can have a juridic entity, or being part of an agreement, or being part of a funded project. In addition, they can be short-term actions for a specific project development, mid-term actions constrained to the lifetime of a funded project, or long-term initiatives linked to a political bet. In all the cases, the proposed method and Canvas provide viable pathways.

In addition to the positive impact from a methodological perspective, the Governance Model Canvas has another strong point: it provides the foundation document for the commitments, serving as the reference point for the edition of official agreements and the follow-up of procedures.

The Canvas also allows for the iterative definition of the model, which, in many occasions, will have to be adapted to changes in policy priorities, funding availability and partners commitments. Having a strong and structured starting point would allow, in this situation, to provide a systematic way of tackling the transitions.

The 4-helix model implies building up strong foundations, underpinned by trust. And the definition of the Governance Model (as a process in itself) represents an excellent machine à penser and an opportunity for trust-building among the stakeholders.

4 COLAB MODEL: LAB OF LABS
Collaboratories: universal innovatio systems for climate change and the energy transition

Artur Serra, i2Cat Foundation

4.1 How can we face global challenges?

The challenges facing humanity, such as climate change and the energy transition, digitization or growing social inequalities, are new and have a global scope. They have one common characteristic in that they are anthropogenic challenges, meaning that we have generated them ourselves as humans. Therefore, the solution can come from us, from our capacity for innovation and our determination, from a joint effort between academic, political, economic and social actors in each region, country and on a global scale.

The scientific community itself began to become aware of the climate challenge in the 1960s. It was this community that launched the Global Change program which has been collecting evidence of said change continuously in order to make the international community aware of its seriousness. This work of the research community was accompanied by the birth of a young and broad international environmental movement, a pioneer in conservation policies and in the defence of renewable technologies and the circular economy. Over time, these analyses and mobilizations have transformed public policies until they have converted into new strategies and changes in business models.

However, this effort has not yet managed to reverse said climate change or to cause radical change in the economic, social and cultural model. Given the delay in making the necessary changes, a feeling of pessimism has begun to spread throughout the young generations in the face of an eventual collapse of the system itself.

Are we to wait for catastrophic weather events to force us to take transformative action? What has happened during the last pandemic seems to indi-

cate that humanity only makes great transforming collective efforts when facing dramatic dilemmas.

It was the threat of an uncontrolled global pandemic caused by a new SARS2 virus that prompted an immediate, simultaneous and hugely collaborative effort across all countries. To stop the spread, two types of innovation were set in motion:

A. Innovations of a social nature such as generalized international confinement and reduction of mobility on a global scale, never before seen in history, also referred to as Non-Pharmaceutical Interventions.
B. Medical innovations such as the acceleration of R&D aimed at the global production and distribution of a new type of genetics-based vaccines.

This combination of innovative social measures (which were in part contested by a certain percentage of the population), the innovation in vaccines itself, the orchestration by an interdepartmental political leadership, advice given by experts and research groups in immunology, public health and statistics, and the tireless work of millions of socio-health professionals, educators, workers in basic need sectors, social activists, families and the general public prevented the collapse of the current health systems. Such a mobilization had not been seen since World War II in the 20th century. But a fundamental change has taken place: it is now about saving millions of human lives.

It does not seem unreasonable that we could begin to prepare for a similar mobilization in the face of climate change, which is already beginning to cause widespread disasters. The year 2022 has been declared the hottest of all years on record since the 17th century, and it does not look like this upward trend will be reversed on its own.

4.2 Changing innovation systems in the face of climate change

This transformative mobilization to stop climate change must also include a

change in the systems of innovation themselves. The scientific community, which initiated the discovery of the problem decades ago, now has a key responsibility in its approach.

The change that seems to be already taking place implies two transformations:

A. A transformation of the type of research and innovation we carry out.
B. An opening up of the innovation community to the whole population.

Let's start with the first change. Until now, the scientific community has focused on analysing and measuring it on a global scale, finally concluding that it is of anthropogenic origin. This work has reached a point of international majority consensus, despite the fact that a minority of the community itself still questions it. But the analysis does not change reality; simply allows us to understand it.

Now the next step is to start an innovative and transformative investigation, capable of making it possible to prevent the change from continuing and can revert it on a planetary scale. There are already efforts to develop this "transformative research", named after Ardent Bement, director of the NSF in 2007 [18]. Currently, there is an international community of researchers, based mostly in the EU, which is called the Transformative Innovation Policy Consortium. This community is dedicated to applying this type of research and innovation to the transformation of public policies, placing environmental and social problems at the centre [19].

Secondly, this change, this transformative innovation, cannot be made by scientists alone. The innovative commitment of society as a whole is needed, but most notably that of the countries, such as those of the G20, which are responsible for 80% of the production of greenhouse gases. Community experiments such as the one on the island of Samso in Denmark, the first energy self-sufficient island based on renewable sources [20], indicate that it is not impossible. The whole community can be involved in the implementation of innovative solutions.

The European Network of Living Labs has been the pioneering organization at a European and international level in supporting this radical change in innovation systems, which involves the social group in solving the problem.

The term Living Lab was used for the first time by the architect William Mitchell at MIT in the field of City of Bits, or digital cities. But shortly after it was taken up by European researchers. The "Collaborative working environments" program of the FP6 promoted by DG INFSO (which is today called DG CONNECT) of the European Commission approves a set of projects such as CORELABS [21] or APOLLON that led to the creation of the European Living Labs. Alongside this, in 2006, the Finnish Presidency of the EU facilitated the creation of the ENoLL network, the European network of Living Labs.

The motto with which the ENoLL presented itself to the world was "Towards a new European innovation ecosystem". It was and is therefore a matter of transforming the innovation systems themselves, opening them up to the population as a whole.

Initially conceived as testing methodologies with end-users for SMEs with the aim of minimizing risks before going to market, Living Labs have moved towards an approach that is more focused on their true initial purpose: opening up innovation systems to the entire population in order to be able to solve the challenges of our era.

Living Labs have become moved closer and closer to quadruple helix models, whose most disruptive meaning includes "citizens" as the new actor for the innovative resolution of challenges alongside academia, governments, and companies. And as it was seen at the ENoLL conference in Amsterdam in 2014, they are "Empowering everyone to innovate".

Living Labs are being developed in real environments and for this reason they tend to transform social reality into an experimental environment, into a lab. As the motto of the last ENoLL congress held in Torino in September

2022 proclaimed: “The City as a Lab, now for real”. Together, communities and territories can potentially become labs.

In this sense, the Living Labs and the Tr@nsnet project are synergistic. One difficulty that Living Labs have had in terms of their development is opening up each one of the helixes that make up each Living Lab. That is why, Tr@nsnet’s proposal to transform universities into Living Labs which open their territorial campuses to innovative interaction of its environment with the whole population is a way to explore. If it is achieved, it is an experience that can be scaled to a global level, since universities are an existing structure in every country on the planet.

4.3 Living Labs as a new social technology

An interesting and still underappreciated aspect of Living Labs is that this idea emerges as a social innovation rather than a digital technology. In fact, it has been taking shape as a new field of research as a social technology. ENoLL considers Veli-Pekka Niitamo, a Finnish psychologist and former Nokia employee in Espoo, to be the father of European Living Labs. In fact, the Living Labs connect with the Nordic tradition of participatory design that seeks to involve workers in the design of systems. The next step was Collaborative Working Environments (CWE) and finally with the generalization of the Internet, such collaborative design could be extended to the entire population.

Living Labs have emerged step-by-step as a new type of ecosystem that allows for the promotion of open and collaborative innovation between researchers and the other structures in society. From being seen as a “methodology” for the involvement of “users”, it has gradually become a new “structure”, a new “system” of innovation. And innovation systems are social systems like any other.

The Living Labs align with a long European tradition in the field of social innovation. After WW2, European countries launched a whole program of social innovations. For example, Great Britain launched the National Health Sys-

tem, which for the first time meant that every citizen could be cared for in case of illness. Later, other universal systems were put into operation, such as education, first with the compulsory nature of primary schooling and later in secondary school. Finally, the first open university was invented, the Open University, designed by the sociologist and innovator Michael Young to give access to higher education to the entire population [22].

These innovations attempted to reduce the social gap generated by industrial society. Now we are faced with uncontrolled climate change generated by that same industrial society, some new and still poorly regulated digital technologies, and a society perplexed by these two great changes that it still does not know how to control.

One of the first fields of application of this new social technology has been and continues to be the energy transition. The APOLLON [23] or SAVE ENERGY [24] projects were pioneers in generating the first "Energy Living Labs"[9]. Currently, the ENoLL continues to work in this field through the Action Oriented Task Force on Energy, led by the Swiss researcher Joelle Mastelic, director of the Energy Living Lab Association. This entity works to develop quadruple helix models, with the involvement of the communities in the generation of energy sustainable systems.

But the green transition is already inseparable from two other global transitions: the digital and the social. The European Union has already approved the "Green" and the "digital transition" for its new Horizon Europe programme. Formulated before the COVID health crisis, it has highlighted that, alongside these existing transitions, it is necessary to include a "social transition" that can guarantee a socially inclusive solution to current challenges. Together, this becomes a "triple transition".

9. *"First National network of Living Labs" took place in 2007 when Dimes was formed to co-ordinate it and Mr. Niitamo became a chair of it from CKIR/Helsinki School of Economics. Regional and thematic clusters were defined late 2007. The formation of ICT for Energy efficiency as thematic area for Living Labs in Finland was identified in 2008 and first meetings were held with interested parties and SMEs in early 2009"* [68]

4.4 Collaboratories: universal innovation systems to solve the triple transition

Living Labs now need to scale to true labs of labs and collaboratives; universal systems that encompass the set of innovation systems, including the group of people and territories to resolve the "green, digital and social transition" in a coordinated way.

The first person to use the term "national collaborative" was Willian Wulf in 1989. He was director of the National Science Foundation and used to refer to a "centre without walls" that could bring together the entire North American scientific community at a time when the Internet had barely 4 million users, which was the scientific and technological elite of the USA. In 2022, this same network already connects 5,000 million, 63% of the world population in practically all the countries of the globe, according to 'Digital 2022 April Global Statshot' [25].

Within this same network there has been growing explosion of innovative initiatives and projects, que have produced a vast generation of highly diverse labs: Living Labs, fablabs, policy labs, citylabs, citizen laboratories, citizen science groups, etc. Many of these initiatives are outside the current official innovation systems, although they do form part of a peripheral network to the official systems. After each crisis, these initiatives have grown, the Internet being the digital network that interconnects them and allows them to strengthen their collaboration. On the other hand, the official innovation systems themselves have also been affected after each crisis and also continue to use the Internet for their operation. Without this network, programmes such as Horizon Europe, which must involve at least three countries, simply would not work.

The hypothesis that we put forward is that it is possible to integrate both systems, generating true universal systems of innovation. We call this system a *collaboratory* that allows the generation of a new persistent social structure,

with a digital base and open to the population as a whole for the innovative resolution of common challenges.

The Internet is not just another digital network. It is not even a digital information and communication network as is commonly claimed. Its original function, which it is still used for and which gives it its distinctive value, is to constitute a network of and for research and innovation. Its predecessor, ARPANET, in addition to being a digital network, was the network of ARPA labs, centres in universities or companies that worked for DARPA, the advanced projects agency of the US Department of Defence. In turn, its successor, NSFNet, was the network for the rest of the North American scientific community. Today we could say that the Internet is also the experimentation network of Google, Facebook, and other large corporations to extract information and knowledge from the billions of users in order to test new technologies and advanced applications with the direct purpose of maximizing their benefits. But this monopoly of the network is holding back its further development and limits the development of open and collaborative innovation systems.

The challenge now Internet researchers is to indicate how innovation systems can continue to develop in the digital age, how to open up a largely monopolized and limited-growth Internet, and how to connect this social and digital innovation with the ecological transition which is working in unison as a single global and territorial triple transition.

4.4.1 The Col·laboratori.cat programme

In Catalonia we are currently developing the Col·laboratori.cat program as the first demonstrator of the possibility of generating a universal innovation system on a regional scale [26], which in turn serves to address this triple transition in the region.

This program is sponsored by the Generalitat's DG for Digital Policies and is run by the Fundació i2cat. Its first objective is to test the collaboration be-

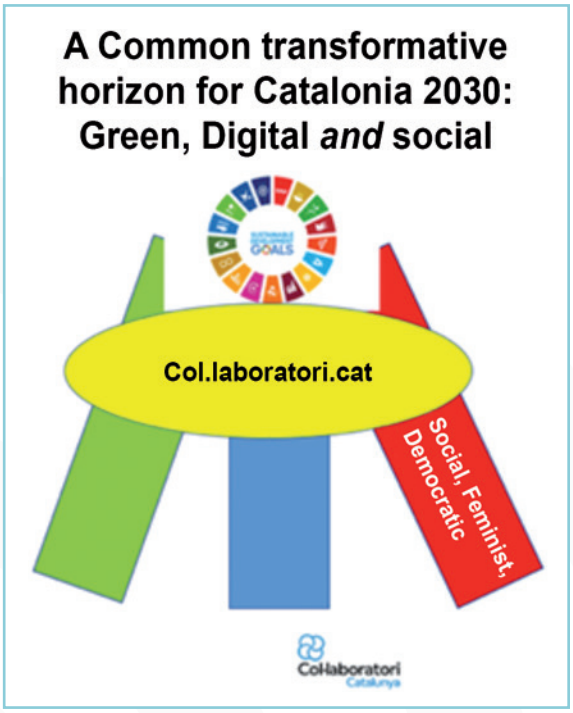

Figure 14: Conceptual diagram of Col-laboratori Catalunya. Source: [27]

tween the actors of the official research and innovation system of the region with the extensive network of labs and innovative actors in the territory in order to take a first step in the construction of a universal system at a regional level.

Since the opening up and irruption of the Internet from the mid-90s until today, Catalonia has seen an active open community of research, innovation and entrepreneurship that is both economic and social, grow in the warmth of this network of networks. This reality, which also exists in other European regions, has been studied by the EC Joint Research Centre and defined as "placed-based innovation ecosystems" [28]. This study has shown the enormous number of innovative initiatives at the local level which were developed in Barcelona, a European city which is member of ENoLL and also where the largest concentration of Living Labs is located. This city already won the prize for European Innovation Capital in 2014 [29] in its first edition.

For its part, Catalonia was considered the third favourite European region as a "start-up hub" in 2020 [30]. According to the DESI indicator, Digital Economy and Society Index (DESI) adapted to a regional scale, in 2021 it would rank fifth among the digital countries of the EU27 [31]. These data contrast in part with those of the European Regional Innovation Scoreboard 2021 [32]. According to this, the innovation system in Catalonia is considered only as "moderate innovator". Its main deficits are the weak innovative capacity of companies and the delay in life-long training, which can be seen in the graph below.

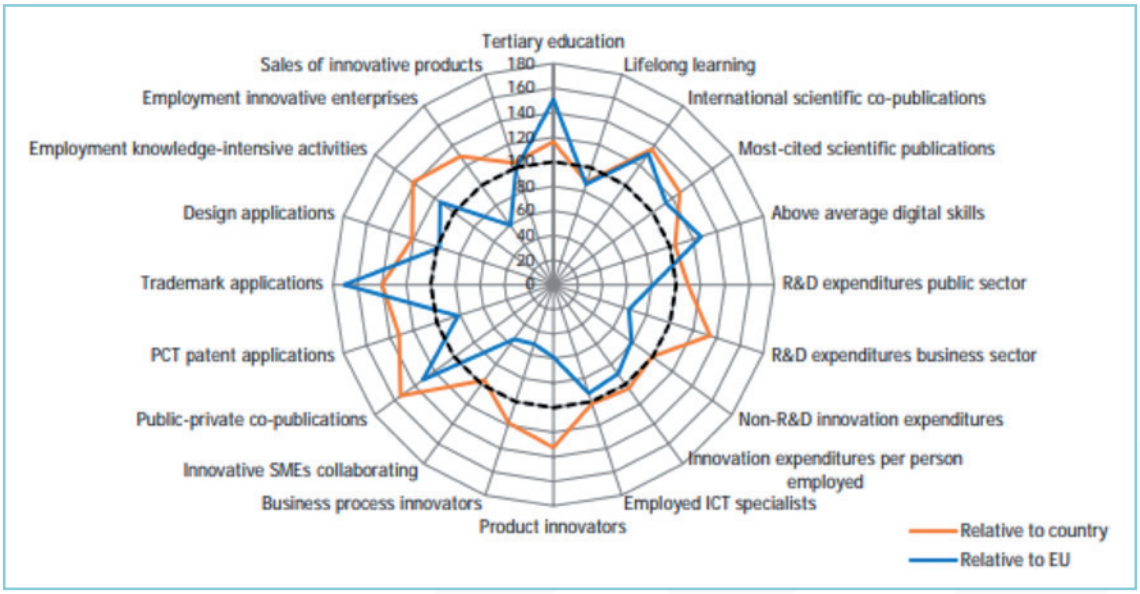

Figure 15: Results for Catalonia in the European Regional Innovation Scoreboard. Source: [32]

This difference between indicators may be due to the fact that innovation systems based on digital technologies are still emerging and have not succeeded in transforming the entire economy and society in the region. The possibility of taking advantage of the digital innovative community to reinforce and transform the entire innovation system in the region was the initial purpose of the Col·laboratoris 1.0 project [33]. On the other hand, we have also been interested in developing a more distributed model of the digital innovation system. Barcelona and its metropolitan area are not only home to 70% of the population of Catalonia but they are also home to the vast majority of its start-ups. This encouraged us to start the project outside that area and look for another territory in Catalonia. It is therefore a matter of overcoming two divides:

- The difference between the digital system and the rest of the regional innovation system
- The difference between the hyper-concentration of the innovation system in the city of Barcelona and its enormous distance from the rest of the territory.

The project began in 2019 and is currently in its third year of development.

4.4.2 The first prototype: The CatSud Collaboratory

The Colaboratorio 1.0 project began as a research and experimentation project that focused on models of universal innovation systems. We started the first prototype in the southern territory of Catalonia, and we called it Colaboratori CatSud and its development still marks the Collaboratori.cat program as a whole today [27]. At the beginning of 2023, this program already includes three territorial collaboratories (CatSud, CatNord and CatCentral), and a thematic Collaboratory in Health and Well-being. At the same time, two recently approved European projects within Horizon Europe, INTEGER and FORGING, are using their methodologies to formulate similar experiences on a European scale.

The first collaboratory to consider is ColabCatSud. This social experiment is unfolding in the south of Catalonia. This territory includes the province of Tarragona in its entirety and includes 184 municipalities distributed in two functional areas or "veguerías": El Camp de Tarragona, which is more industrial and urban, and Terres de l'Ebre, which is more rural and agricultural. It is a territory with an area of 6,283 km2 and a population of 802,547 inhabitants, according to Eurostat. The largest city and its capital is Tarragona with 132,299 inhabitants.

The local university (the URV) together with the Tarragona Provincial Council (which includes all the municipalities in that province) carried out a strategic prospective study in 2018 called Catalunya Sud 2040 [34]. The main objective of the exercise was to generate consensus among local stakeholders regarding the need and possibility of becoming a "knowledge region", creating a second hub separate from Barcelona in the south of the region.

The first of the challenges posed as differentials in this region was the "energy transition" and "climate change", a key issue for this territory. The province of Tarragona has the main petrochemical complex in southern Europe, with three active nuclear reactors that are the main source of atomic energy in the country, four combined cycle plants and twenty wind farms plus authoriza-

tion for another ten (meaning it has the largest concentration in Catalonia), and also a hydroelectric power station. Finally, it is the region that the river Ebro, the largest river in the peninsula, flows into, providing a necessary source of water, for example, for the generation of green hydrogen. Curiously, this study did not contemplate any axis of work on digital technologies or on Living Labs as a way of structuring its "region of knowledge".

The Col·laboratori CatSud project began as the initiative of i2cat and brought together a group of innovative institutions and initiatives that we discovered in the territory, including two paradigmatic institutions. One was the Rovira i Virgili University [35], the university of reference in that territory, particularly in the field of energy transition and author of the CatSud 2040 study, and the other was the CoEbreLab [36], the digital social innovation project that was most representative in that territory also.

The URV is the most significant pillar of the official research and innovation system of that region. Created by the government of Catalonia as a public university in the 1990s, the URV is part of three other universities (the University of Girona and the University of Lleida) distributed throughout the other provinces of the region within a policy of decentralizing the university system that focuses too much on Barcelona. It has research centres of excellence in the field of chemistry and the environment.

The second centre, CoEbreLab, is a community initiative of innovative technicians from the Ribera d'Ebre Regional Council which is dedicated to promoting social and digital innovation among the different town halls and the citizens of that region. It is a territory made up of 17 small municipalities that occupy an area of 825.29 km^2 and with a combined population of only 23,867 inhabitants. CoEbreLab is located in its capital, Mora d'Ebre, and provides a service to all the neighbouring towns.

Together with these academic and public administration institutions, we also incorporated a business actor, CENFIM, the cluster of wood and furniture companies with more than 100 members. This cluster set up an innovation

team, the INTERIORS Living Lab [37], which has been a driving force behind the transformation of this cluster, prompting it to become a main design and manufacturing cluster for the hotel industry in the region in recent years.

Lastly, we incorporated a set of Vocational Training centres grouped in the Campus Educatiu de Tarragona [38], the headquarters of the old Universidad Laboral. These centres share the desire to promote a leading research and innovation centre in vocational training, inspired by a similar centre already in operation in the Basque Country, the TkniKa [39].

Figure 16 shows this group of centres and institutions that began this pilot program at the end of 2019 and that today (2023) constitute the fundamental nucleus or Secretariat of Colab CatSud.

Figure 16: Col.laboratori-CATSUD: First pilot 2029-2020. Source: [27]

Initially, the collaborative dynamic used was based on a mutual discovery of the different institutions and projects that are carried out in that territory. And it continues to do so.

CoLabs are open innovation structures. This means that they maintain a permanent attitude both to incorporate new innovative initiatives that exist in said territory and to generate new ones. This is the basic methodology of the behaviour of a CoLab: a permanent discovery of local innovators in order to

incorporate them into the process of co-creation and collective innovation. One obstacle that was encountered was that the European Commission's indicators, such as the European Regional Innovation Scoreboard mentioned above, do not go into the detail of analysing innovation in the different territories within the same region. In the EU classification, Catalunya is catalogued as the ES51 European region. Below it, only the city of Barcelona exists as a metropolitan hub of European reference. CatSud does not exist in terms of European, nor Spanish, nor until now Catalan innovation policy.

To highlight this differential reality, the URV stared work on defining its own "region of knowledge" in that territory, which it called "CatSud". In 2018 and in conjunction with the Provincial Council of Tarragona, the counties and their main town halls, the URV carried out a prospective exercise called CatSud 2040, the Regió del Coneixement, which was a first approach to this need for recognition [34]. In turn, the URV created a Regió del Coneixement Chair that has been publishing monographs on the hottest topics in the territory, including the energy transition [40].

In 2019, the Col·laboratori CatSud project [41] resumed this effort and expanded the range of challenges to be faced in this territory. The first step in doing so was to introduce a Living Labs structure and methodology. The CatalunyaSud 2040 study had already been designed based on the quadruple helix. It included interviews with 250 people from the academic, business, political and social world. But this collaboration was not systematically organized and it wasn't until the Colaboratori CatSud took over that it became organised.

Secondly, i2cat has been promoting two 5G digital areas in that territory: one in the Terres de l'Ebre *veguería* (led by CoEbreLab) and another in Camp de Tarragona (led by the URV). These areas are trying to accelerate the deployment of 5G technology in the different territories of Catalonia.

Regarding Col·laboratori CatSud, a very relevant aspect of its successful implementation was that it promoted not only mutual discovery, but also mutu-

al recognition between official and unofficial innovation entities of the territory itself. Thus, URV researchers promoted the prospective study CatSud Region of Knowledge at the same time that an innovative local citizen initiative, the Ciutat Savia Colab de Reus project led one [42], but they did not see that both initiatives could form part of the Same community, same innovation system.

Traditional innovation system models only consider institutions with official competencies in the field, which are normally universities and companies, as members of these systems. Local institutions such as town halls or county councils, along with their corresponding teams of technicians, in principle do not have innovation powers. Only recently, and by way of facts, city councils are beginning to appoint innovation policy makers to promote actions that can be awarded European funds.

The same happens with university professors and professors from vocational training institutes, whose paths do not cross. The former enjoys a status of researchers and innovators that is denied to the others. But a new reality begins to emerge. On the one hand, Vocational Training, in the EU "vocational training", is awakening innovation, although this function is not formally recognized. The InnovaFP program [43] launched by the Catalan Department of Education is a good example of this. On the other hand, the universities and especially the territorial ones, are increasingly called to help the business and social fabric to awaken entrepreneurship.

Finally, the official innovation systems are still a long way from recognizing that the citizens themselves are beginning to autonomously organize themselves in a way that promotes innovative solutions, as is the case of Coebrelab or Ciutat Savia Colab.

The Col·laboratori CatSud project has been, and continues to be, a framework where both university research groups and social innovation projects led by innovative municipal technicians or by the citizens themselves have been considered to be part of the same community and of the same innova-

tion system. It works in an open and collaborative way and its governance structure is equal to equal, "peer to peer". And for the time being it functions well.

4.4.3 Integrating initiatives and agendas: The Hydrogen Valley, the Col·laboratori CatSud, the Digital Areas and the Regions del Coneixement program

At the beginning of 2023, the territory of CatalunyaSud already has a list of initiatives that could finally come together in a true integrating and inclusive innovative ecosystem, in a great collaboration to face the triple transition (green, digital, and social) in this territory.

On the one hand, and as a result of a huge effort made mainly during 2022, a great energy transformation initiative is being established under the leadership of the URV itself: The Hydrogen Valley of Catalonia.

It is coordinated by Professor Jordi Cartanya, chemical engineer, editor of the CatSud 2040 vision, promoter of the Ciutat Savia Colab initiative and co-founding member of the Collaboratori CatSud. This initiative began in October 2020 as the CatSud Green Hydrogen Platform in Tarragona and has now become the Vall de l'Hidrogen (Hydrogen Valley) de Catalunya community [44]. Its objective is to "constitute the green hydrogen ecosystem of Catalonia" by participating in the European strategy on this issue.

Until today, the project has the main support of a group of large companies in the chemical and energy sector (Enagás, Repsol, Chemical Business Association of Tarragona (AEQT), Celsa Group), with two public universities (URV and UPC), different administrations regional and local authorities (Generalitat de Catalunya, Diputació de Tarragona, Àrea Metropolitana de Barcelona (AMB) and two port authorities (Port of Tarragona and PortBarcelona). More than seventy companies have come together around this nucleus: more than fifty public bodies, fourteen associations and clusters, four chambers of commerce and fourteen knowledge and research centres, including i2cat.

Within this project, a "knowledge alliance" has been created, made up of the main research actors of said consortium: the Rovira i Virgili University (URV), the Polytechnic University of Catalonia (UPC), the Catalan Chemical Research Institute (ICIQ), the Energy Research Institute of Catalonia (IREC) and the Eurecat Technology Centre. They are institutions with excellent research and innovation teams specialized in the field of energy and chemistry.

This initiative, which has generated a large institutional consensus, faces the challenge of how to push forward an energy transition by developing an energy source, or an "energy vector", such as green hydrogen, an alternative to fossil fuels. It is part of the set of "hydrogen valleys" that have been generated in various Spanish autonomous communities. Finally, the central government unveiled the H2Med in December 2022. This was the first renewable hydrogen corridor in the EU for the European call for projects of common interest (PCI). This includes a maritime gas pipeline between Barcelona and Marseille (BarMar). Its main field of application is industrial. It remains to be seen how citizens can be more involved in its development.

On the other hand, in that same territory, there are two initiatives led by Fi-2cat: the Colaboratori CatSud and the 5G Digital Areas. They have started a process to seek synergies that favour the social and digital transition in that territory. The URV, a new member of the i2cat Board of Trustees, has a new rectory team that is aware of digital technology research and is in favour of reinforcing the digital and social strategy in the region. For its part, the regional government, the Generalitat, has just reorganized its digital policy, creating a Secretary for Telecommunications and Digitalization in the Department of the Presidency and a Secretary for Digital Policy in the Department of Business, increasing its commitment to the digital and social transition in the region. The Fundació i2cat has come to depend directly on the Ministry of the Presidency of the Catalan government.

Lastly, in 2023 the Generalitat is preparing to launch the "Regions de Coneixement" programme [45], as part of the new version of RIS3CAT, the territorial specialization strategy. This new program is led by the Department of the

Economy and the Ministry of Universities and Research and is aimed at generating territorial research and innovation communities in the region based on the "shared agendas" methodology in order to address common challenges.

The new RIS3CAT and this shared agenda methodology are supported by an international community of researchers and policy makers and investors, the Transformative Innovation Policy Consortium, which is dedicated to promoting innovation policies focused on solving environmental and social challenges [19].

At this time, these different initiatives when considered together pose the three main challenges facing the international community itself: the "green, digital and social transition" [46]. There is the possibility of generating a shared agenda and a community of collaborative innovation among them, which turns this territory into a real Living Lab of a new generation, into a true collaborative or universal innovation system.

4.5 Constructing a "collaboratory innovation canvas"

Collaboratories are beginning to emerge as a new socio-digital technology aimed at generating new innovation systems, integrating different communities, projects and labs, starting in each territory. We highlight three initial elements of a "collaboratory canvas".

The "value propositions" can be summarised in five points:

A. They allow the integration of the different innovation actors in a certain territory grouped into different types (Living Labs, fablabs, social labs, edulabs) creating a "lab of labs".
B. The interconnection of the different initiatives makes it easier to learn about existing projects and generate new ones in that territory, producing transformative research, research-innovation, oriented towards common challenges.

C. The integration of actors and projects is aided by the use of advanced digital technologies for the collaboration and management of complex research and innovation projects.
D. These new collaborative communities allow for a better implementation of regional innovation strategies based on the territory.
E. Finally, CoLabs emerge as a new social technology whose horizon is the design and construction of universal innovation systems.

The methodology for construction synthesizes different forms of "participatory design", "open innovation", "Living Labs", "social innovation labs" etc. The novelty is in its universality, its territoriality and its proximity. It is a "Km0 research-innovation".

Based on our still very limited experience, we tentatively suggest the following steps to get CoLabs up and running:

1. The first thing is to imagine the new type of society in which we would like to live. In our case, our starting point was a vision of the digital society, the knowledge society, as a complex and rich universal system of innovation.
2. STo move in this direction, we begin with the "innovator's discovery" stage, the search for local innovators, from any sector, institution, or entity, grouped or not in different types of labs or initiatives that are already trying to change their reality. Innovation begins with people and the way to generate mutual trust is to empathize with their projects and initiatives and to value them.
3. This empathy creates opportunities for meetings, exchanges of ideas and projects that are slowly creating the collaboratory, such as an open community of innovation on a territorial scale, a lab of labs, which develops existing projects and helps generate new ones to solve common challenges.
4. This co-creation activity uses existing or new collaborative digital technologies as tools at the service of social innovation. Digitization without social transformation is not digitization. Social innovation without digitization is very limited.

5. We produce socio-digital innovations that partially or completely solve the challenges posed and that help us build the transformation process from one society to another. Innovation is not a means of doing business. It is a way of life. It is an end. It is the new way of business.
6. In this process, we train new generations of innovators from that project work. You learn by innovating. You do not learn first and then innovate after.
7. Finally, the financing of the CoLabs is achieved with projects. The first thing is not the "business plan". The first thing is the "innovation project" or better the "collaborative innovation project".

The construction of universal innovation systems in the form of collaboratories poses new and complex problems. What if these innovation systems end up becoming control and domination mechanisms in the hands of a new corporate elite or large bureaucracies? These entities currently control a huge amount of personal data that they use for their own purposes. Could the new socio-digital innovation systems further increase this control? Today there is already talk of "responsible research and innovation". Should we not we apply this same principle to the design of these new knowledge generation systems that already involve large sectors of the population? Is a new ethic necessary for such collaboratories?

5 IMPACT METHODOLOGY From innovation to Positive Impact

Francisco Palao, Purpose Alliance.

5.1 The era of Positive Impact

Human beings are a fascinating species: Always exploring. Always chasing new achievements. Always evolving.

Since Homo Sapiens appeared on Earth approximately 300,000 years ago, we have gone from being a nomadic species to mastering different hunting and fishing techniques to survive. We learned to create all kinds of utensils with stone, as well as with different metals that helped us create new tools that made our lives easier. Discoveries and advances in medicine have allowed us to double our life expectancy from approximately 35 years to over 70 today. We discovered electricity and learned to manage it to produce energy, light, heat and provide our homes with endless possibilities. We have created value exchange systems, inventing the concept of money and creating a space for the economy, markets and business. Human beings, always with the purpose of improving our own existence, have the amazing ability to imagine something that does not exist and make it come true.

In fact, it is precisely the ability to dream and to create that humans have that has given rise to endless technologies that make us who we are as a species. Technology is a key element of the human being that has allowed us to continuously increase our capacities and to limits which we would hardly have imagined in the past. Today any one of us has access to a range of technologies that a few years ago would have seemed like science fiction, such as the Internet, which provides us with unlimited access to information and new ways of living, as well as many others such as 3D printers and Artificial Intelligence.

Today, literally from the palm of our hand, all of us have access to an abundance of information that even a few years ago the people with the most fi-

nancial resources and possibilities could not aspire to. Most of us have mobile phones with a processing capacity millions of times greater than that of the supercomputer of Apollo 11, the NASA spacecraft that put the first man on the moon. How has all this become possible?

The reality is that technological evolution, far from slowing down, is continuously accelerating. It was Gordon Moore, one of the co-founders of Intel, who correctly predicted in 1965 that the number of transistors in microprocessors would double approximately every two years. Shortly after, this prediction would be known as Moore's Law and would give rise to the concept of 'exponential technologies', which are those that each year double their power or speed, or whose cost is reduced by half. In general, any technology that uses computing power in some way can be considered exponential technology, since its advancement follows the same pattern defined by Moore's Law.

However, human beings are not prepared to think exponentially and that is why it is difficult for us to predict the future, which will increasingly be determined largely by the development of exponential technologies. Let's consider an example that will make us all understand why people are usually better at thinking and predicting in a linear and non-exponential way. Imagine that we want to calculate how many metres a person taking 30 linear steps would advance, each step being exactly 1 metre, the answer would be very simple for all of us: 30 metres would be the distance that the person would travel with 30 linear steps. If we now ask ourselves the question but make it exponential, meaning we ask ourselves how many metres we would advance if we take 30 exponential steps (which means that the first step would be 1 metre, the second 2 metres, the third 4 metres, the quarter of 8 metres, etc.). The answer will likely surprise us all: 536,870,912 metres, that is, more than 42 times around the Earth. This is why it would be very difficult (if not impossible) to predict for any of us where exactly this person would have ended up.

Similarly, predicting where exponential technologies will take us in the coming years is extremely difficult (or perhaps, again, impossible). What we can do is predict its consequences and, for this, Peter Diamandis presents us with

his famous 6Ds model, which tells us that any environment in which exponential technologies are implemented in any way is always affected by the following implications, known as the 6Ds:

1. **Digitization:** In some way, everything we do or the information we manage is affected by digitization. A good example is the number of applications that we have on our mobile phones today, which not so long ago were physical objects that have been replaced by these digital applications (agenda, camera, recorder, etc.).
2. **Disappointment:** Initially, the results offered by the technology are not of great quality, so it is very common to feel disappointed in these early stages. However, exponentiality should not be underestimated since, if in the short term it tends to develop above our expectations, in the medium term it is most normal for it to exceed them by far.
3. **Disruption:** There comes a time when everything we did in a certain way changes completely as technology changes the rules of the game. We only have to think about the encyclopaedias that we used a few years ago and how everything has changed thanks to the arrival of the Internet and, with it, the ease of access to knowledge.
4. **Demonetization:** Costs drop dramatically thanks to the power of computing, the automation of all kinds of tasks and digitization in general. A few years ago, it was necessary to acquire the newspaper to read the news, today, on the other hand, it is possible to do so through digital platforms and even the web pages of the newspapers on the Internet.
5. **Dematerialization:** Dematerialization is the stage where we can see which tools lose value and can be replaced. A good example is photographic film, which lost momentum until it disappeared completely from the market.
6. **Democratization:** Possibly the most important implication of all, since it tells us that everything reaches everyone. It is precisely for this reason that, thanks to the democratization of exponential technologies, any person or entity today has more power than we could have imagined a short time ago.

It is precisely the democratization of access to technology and to opportunities in general that has made it easier for a number of innovative products to

be launched on the market in the last ten years, much higher than those that had been created in the previous hundred years. They have also given rise to a new paradigm in the business world, with the emergence of start-ups and the emergence of the era of digital innovation. There is no doubt that technology and innovation have been one of the main engines that have accelerated our society during the 21st century.

This new environment has given rise to new business management techniques and the development of innovative products and services. Until recently, when a company wanted to develop a new product, it would draw up a detailed plan and put it into action. This technique, known as *waterfall model*, works when we know the problem we want to solve and are clear on what the appropriate solution is. However, in a context dominated by technological acceleration and innovation, changeable and full of uncertainty, fixed plans have ceased to make sense. The needs of customers and the solutions demanded by the market are constantly changing, so it is necessary to implement techniques that allow us to make continuous changes.

This need for new approaches to the development of products and services gave rise a few years ago to the birth of the so-called "agile techniques", supported by the publication of the Agility Manifesto [47] and materialized in frameworks such as Scrum. However, focusing only on agile product development turned out not to be enough. In changing environments and high uncertainty, it seemed more logical to first discover who the customer really is and who is not, that is, to focus on the problem rather than on developing the solution. The first approach in this sense came from Steve Blank, who created a new methodology called Customer Development [48], thanks to which it is possible to develop the customer before the product and create a solution for a real market problem.

A few years later, it was Eric Ries who deepened the application of agile and Customer Development principles by creating Lean Startup [49], one of the most widespread methodologies in the world of entrepreneurship and innovation. It teaches us to implement a continuous cycle and collect customer

input to improve our product through three simple and powerful steps: build, measure and learn.

For a few years now, we have been able to turn technology into real innovation, providing value to users and, for this, all the innovation techniques mentioned above, among others, have made our work easier, allowing us to fail less and bring our innovations to success. Somehow, in just a few short years, we have moved from the age of technology to the age of innovation.

However, it is paradoxical to think that despite all the new technologies and innovations that we have at our disposal, most of the challenges facing humanity continue to exist: climate change, social inequalities, armed conflicts, and many others. Are we really moving forward as humanity?

Fortunately, there is a growing social awareness of the need to create a better world and to guide all our actions in the right direction. The new generations are marked by a deep sense of purpose and try to follow vital and professional paths that allow them to create a positive impact.

The time has come to start acting as a species and not as individuals, taking our purpose beyond improving our own existence and focusing on improving the world in which we live. Today we face important economic, social and environmental challenges that are generating unprecedented global awareness. More than ever in our history, we need to respond to global problems. It is imperative that we take action.

It is no longer enough to innovate, to generate new products and services that create value for customers. It is now necessary to create innovations that improve the world. It is no longer enough to be sustainable. It is now necessary to regenerate those resources that we have consumed and those assets that we have eliminated.

We are moving from the age of technology and innovation to the age of Positive Impact.

In accordance with the ideals of this new stage, in March 2022, a group made up of more than 100 impact-oriented innovators, entrepreneurs, activists and investors from different parts of the planet came together to create the *Manifesto of Purpose* [50], broadcasting a very important message to the world: It is no longer enough to do things the right way (as the *Agile Manifesto* created 20 years ago suggested), but it is also necessary to do the right things. The good news is that we can do it. We can do the right thing in the right way, generating value for our projects and for the world.

As has been the case throughout the history of human evolution, new scenarios force us to develop new techniques and ways of interacting with the world. Throughout the next sections we will talk about the new organizational models and frameworks that are part of this evolution and that constitute the beginning of a new era: the era of Positive Impact.

5.2 Exponential organizations

In recent years, we have been able to observe how a new generation of innovative companies with a high technological component has emerged. They have completely disrupted the status quo, making entire industries and large organizations disappear.

One of the most cited examples, in this sense, is possibly the case of Kodak, which was close to bankruptcy at the time that Instagram was acquired by Google for a billion dollars. Today, it has grown to have a total of 1,270 active users and more than $30 billion in revenue by 2022.

Instagram knew how to take advantage of the democratization of technologies, the last of Peter Diamandis' 6Ds, which generated a very important effect in the world: abundance. As Diamandis himself describes in one of his books called 'Abundance' [51], technology is creating an abundance of information, energy, and many other resources, which is changing the rules of the game in many industries.

In the case of Kodak, the real failure was that they did not transform their business model, which was based on scarcity and was always focused on selling rolls of 24 or 36 photographs. Meanwhile, Instagram promoted a business model based on abundance, taking advantage of the large number of digital photographs that began to be taken every day and that flooded the Internet.

This is the reason why all of us, when we try to think of a new innovative initiative or value proposition that can fit with the current moment, must keep abundance in mind and make approaches that connect with this powerful concept.

At the end of 2014, Salim Ismail wrote a book entitled Exponential Organizations [52] in which he described the phenomenon whereby certain types of organizations achieved growth ten times that of their competitors within their industry. In fact, Exponential Organizations are those that are capable of connecting with abundance and managing it in such a way that they achieve exponential growth, in the same way that exponential technologies do.

Exponential Organizations are characterized by implementing a series of elements, called ExO Attributes, which allow them to both connect and manage abundance properly. They are the following:

- **MTP (Massive Transformative Purpose):** The purpose of the initiative, which is positioned as transformative (since it will have a transformative effect on the world) and massive (since the idea is for the initiative to have a massive positive impact).
- **On-demand personnel:** People from the community who are not employees but who perform tasks to carry out the main activity of the organization in a dynamic way when they are needed.
- **Community:** People and organizations linked to the organization in some way, who can live under a set of rules or share common interests.
- **Algorithms:** Systems and applications that automate organizational activities.

- **External assets:** Resources that, without formally belonging to the organization, are used flexibly as needed.
- **Engagement:** The mechanism we use to retain and keep the community active.
- **Interfaces:** Applications and graphical interfaces that allow us to offer a positive user experience to our customers and members of the community.
- **Dashboards:** A control panel that allows us to define and plot the most relevant metrics for our initiative.
- Experimentation: Techniques and culture of experimentation used to test our hypotheses.
- **Autonomy:** The way in which we will offer decision-making and operational freedom to our teams and even to our clients and members of the community.

However, exponential growth is not always sustainable, and our planet is warning us about it. Similarly, no industry supports continued exponential growth as the size of the market itself has a limit. In the next section, we will see the new trend in organizational models and how current businesses are evolving accordingly.

5.3 Ecosystems based on Purpose

Technology, innovation and even exponential growth are important, but as mentioned above, there is still the pending issue of generating a positive impact on our environment. The good news is that it is possible to do so. As Peter Diamandis himself often says, "*the greatest challenges for humanity are, at the same time, the greatest business opportunities*".

Every day, there are more organizations that define a purpose (in a complementary way to their vision and their mission) to express the way in which they want to contribute in a positive way to the world. We are also seeing how platforms such as BCorp or Purpose Alliance are emerging in line with this trend [53], since it has been shown that the positive impact generated by purpose-oriented organizations is double: in the world and in their own businesses.

There are organizations that have gone beyond exponential growth in a given industry because, as we already know, no industry supports continuous exponential growth. There are organizations that have understood that the concept of industry is not only obsolete, but also creates scarcity, which is why they have decided to go beyond the industry in which they started and today they cannot even be associated with one in particular. Which industry does Google belong to? Which industry does Apple belong to? None, and many at the same time. As we will see below, these organizations have become purpose-oriented ecosystems.

In the past, Apple was a company focused on the computer industry. And that is what they did: they sold computers to their customers. Now Apple has transformed into an ecosystem focused on one purpose: "*Empowering creative exploration and self-expression*". And around their purpose they have created a series of products, services and companies that offer value to their users. Apple continues to offer computers, but also phones, watches, applications, music, online content, and much more. Apple has become an ecosystem focused on a purpose, ceasing to belong to a specific industry.

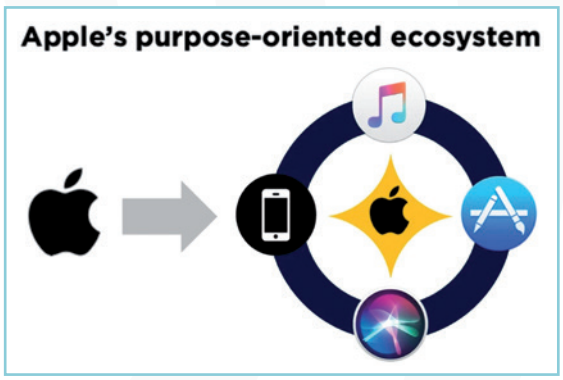

Figure 17: Ecosystem oriented to the purpose of a company, example, Apple. Source: [53]

Purpose-oriented ecosystems attract communities of people aligned with their purpose, who stop being customers of a company focused on an industry, to become users of the different services offered by the ecosystem. The most important elements of this type of business model based on an ecosystem are:

- The purpose, which is the reason for the ecosystem and everything that happens within it. Purpose is at the centre of the ecosystem and shapes everything else with the goal of making a massive impact.
- The community, which are those people and organizations aligned with the purpose and help in one way or another to make it come true. The communi-

ty is the membrane of the ecosystem and the larger it is, the greater its impact.
- The value, which is generated by a set of organizations, products and services that the ecosystem offers to users, to facilitate the world in general, and the members of the community in particular, to do the actual purpose.

When we understand this new paradigm, we can understand many of the things that are happening in the world today. This is the main reason why Tesla has a market capitalization greater than all its 'competitors' in the auto industry combined. Because Tesla is not a company focused on the automobile market, Tesla is an ecosystem with a very clear purpose: "accelerate the global transition towards a sustainable energy model".

One of the most relevant effects that purpose-oriented ecosystems bring is that the user, the member of the community, has much more power than before. In fact, when we find two ecosystems with similar purposes, direct competition disappears thanks to the interaction that is generated at the community level.

Competition from scarcity-based markets is a thing of the past. Members of communities who live their purpose in a real way collaborate and belong to different communities at the same time. Users of purpose-oriented ecosystems use different products and services from different ecosystems, putting what really matters at the centre: the purpose.

Figure 18: Ecosystem oriented to the purpose of a company, example Tesla. Source: [53]

Let's consider another example, now with the ecosystem that Google has generated, whose purpose is "to organize the world's information and make it universally accessible and useful".

Google has created a number of products, services, and organizations around

this purpose that have attracted a global community of billions of people. And it is these people, it is the community, that has the power and they use these products and services in combination with those of other similar ecosystems oriented towards a purpose aligned with that of Google.

Google Search users search Wikipedia (whose purpose is "to benefit readers by being a free encyclopaedia accessible to all") or TED (whose purpose is "to spread worthwhile ideas"), and Google offers this information in your search results. Google Docs users also use Microsoft Word, Excel, etc. product (and other similar products) when organizing your information in different types of documents. Google Calendar users organize their calendar information by combining the functionality of other similar apps like Windows Calendar, Apple Calendar, etc.

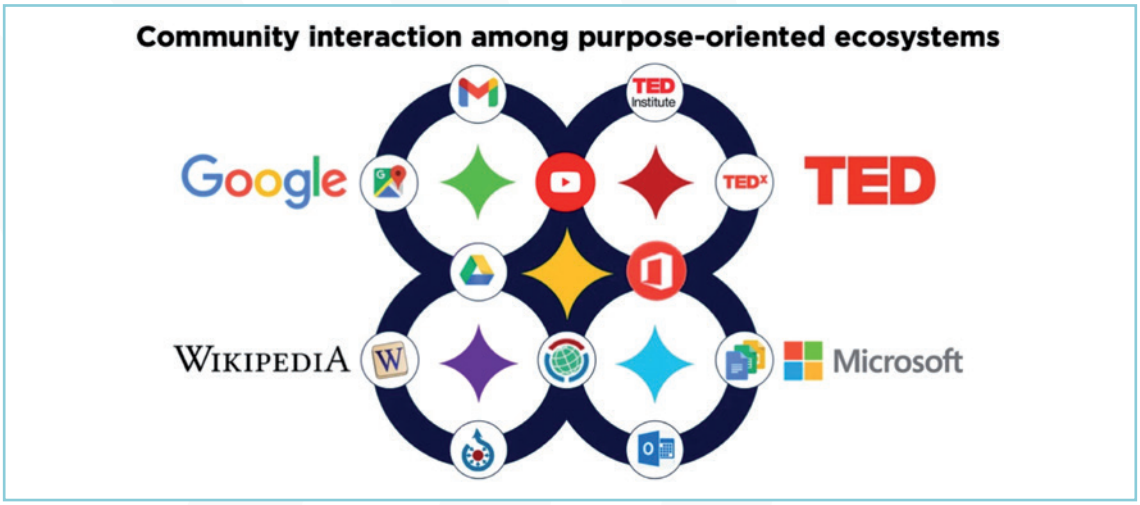

Figure 19: Community interaction among purpose-oriented ecosystems. Source: [53]

In short, Google's purpose is being fulfilled thanks to the ecosystem that has been created around its purpose, and which includes external elements and organizations oriented towards the same purpose, complementing the value for the community. And most importantly, the members of the community belong to multiple ecosystems at the same time, making use of the value offered by each of them to create a massive impact that focuses on the essence of the union of all these purposes, which remains in the centre of everything, as can be seen in the image above.

The power of people and their purpose is making ecosystems that share purpose collaborate naturally. This is precisely a phenomenon that University Living Labs can take advantage of, since people who create new initiatives in this environment can give rise to ecosystems around common or connected purposes of some kind, so we could see in the future that innovators and entrepreneurs who make use of the Living Labs will generate initiatives that connect and collaborate with each other to contribute to a common purpose. The power of purpose is driving new concepts, new ways of doing things, new models and bottom-up approaches that are creating better businesses and a better world.

5.4 The Positive Impact Pyramid

To better understand why purpose-oriented organizations and ecosystems generate more value than those initiatives that focus only on generating economic benefits, I would like to introduce and describe the Positive Impact Pyramid (which I introduced for the first time in my book Positive Impact [54]). It is a model that resembles the pyramid of human hierarchies (also known as the Maslow Pyramid) although, in this case, applied to organizations. The Positive Impact Pyramid presents a series of evolutionary levels that an organization can reach to maximize its results and positive impact, it being essential to reach the levels in order so that it can only go up to the next level if the previous ones have been previously achieved.

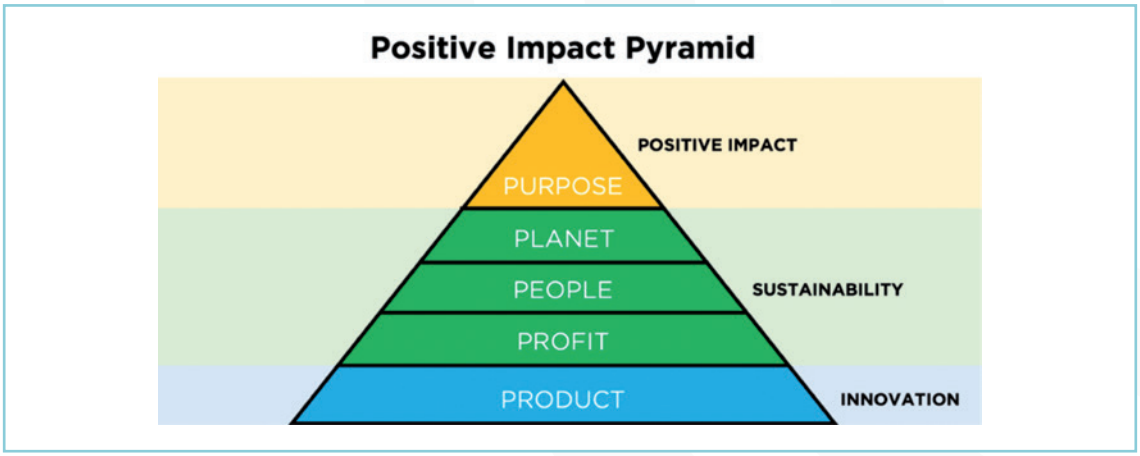

Figure 20: Positive Impact Pyramid. Source: [53]

The basis of any organization consists of having a good product that offers real value to its customers and for this it will be necessary to innovate, but as we have already explained before this will not be enough to take our organization to its maximum potential, since there are still several levels above the Product to be achieved. In the same way that it happens with the Maslow Pyramid, we can only ascend to the next level if the previous ones have been reached. Therefore, once we have a good Product we will be able to generate benefits (Profit) that will allow us to be sustainable as an organization. However, not only must we be sustainable at an economic level, but today we all know that we must be sustainable with society (People) and with the Environment (Planet). This triple sustainability is what will allow us to operate an organization today without consuming tomorrow's resources. In fact, remembering again all the challenges we face, it is no longer enough to be sustainable, but it is important to improve the world in which we live. It is the last layer, the Purpose, that will allow us to direct our actions to generate a positive impact in the world and, at the same time, in our business.

Purpose describes why an organization exists, giving a positive view of the world. At the same time, for each purpose, we can find a series of challenges that the organization and the world must face to make it a reality, so that each of these challenges can potentially become a new initiative, product or service that it will multiply the value of the organization to the world and its results; all in line with his own purpose. Each of these initiatives, around the purpose, are those that can be seen in the figure below.

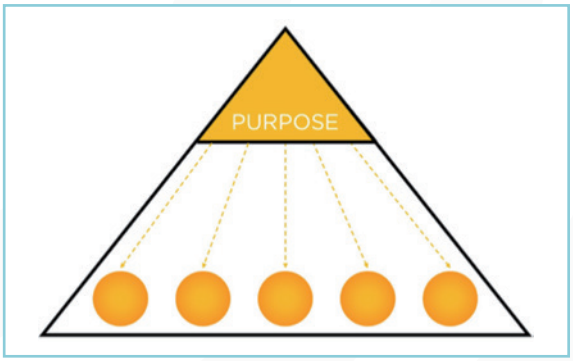

Figure 21: Initiatives within the purpose of an organization. Source: [53]

Returning to the Tesla example, these are precisely two of the factors that have caused the company to increase its value so much in recent years. On the one hand, we see how there is great support from the community from people who are convinced of the energy transition and are clients of the company due

to their alignment in purpose. On the other hand, Tesla's purpose ("accelerate the world's transition towards a sustainable energy model") has led to it solving different challenges that, at the same time, have become business opportunities. Tesla creates a line of electric vehicles to solve energy challenges at the mobility level, launches a line of solar panels to solve energy challenges at home generation level and even has its own domestic batteries to solve energy challenges at the storage. All of these initiatives, among others, have consolidated Tesla as a purpose-oriented ecosystem, thus maximizing its impact on the world and on its own business.

In short, only those organizations that have a good Product will be able to generate Benefits (Profit), which will allow them to be sustainable at a Social (People) and Environmental (Planet) level. And only those organizations that operate in a sustainable way will be the ones that can say that they are Purpose Driven, thus creating a Positive Impact in the world and in their own business.

5.4.1 How to create proposals that generate a Positive Impact

Understanding the evolution of our environment is essential to be able to understand why it is necessary to generate proposals that create a positive impact. However, it is not enough to ensure success since innovative initiatives are always accompanied by high uncertainty. As Steve Blank said: " *there is no business plan that resists the first contact with clients*".

In fact, a business plan should never be considered as a series of actions to be carried out, but rather as a set of hypotheses to be evaluated. To this end, numerous innovation methodologies have emerged in recent years, designed by different successful entrepreneurs and innovators who have transmitted their knowledge through different techniques and tools. Today, entrepreneurs and innovators not only have access to endless exponential technologies that give them countless possibilities, but also to highly valuable knowledge that allows them to minimize risk when innovating.

However, it is not always easy to know which innovation methodologies and

tools to use. In addition, just as we are going a step beyond innovation to generate a positive impact, it is also necessary to go a step further in the application of these techniques. This is the reason why Purpose Launchpad has emerged [55], an entirely new open framework that combines the different innovation methodologies, integrates and organizes them so that entrepreneurs and organizations create a positive impact in the world and in their own projects.

Purpose Launchpad is defined as an agile framework that relies on state-of-the-art innovation techniques to help people act with the right mindset when launching projects, such as new start-ups or new products/services, or to evolve established organizations to create positive impact.

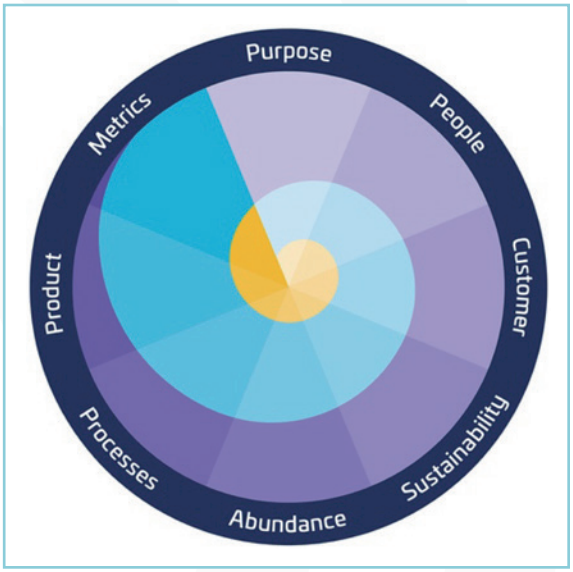

Figure 22: Evaluation axes of the Purpose Launchpad Assessment. Source: [53]

We say that Purpose Launchpad is an agile framework since it creates an environment to develop any type of initiative in an agile way, going through its eight axes (purpose, people, client, sustainability, abundance, processes, product and metrics). It is about starting with the first level (the Purpose) and iteratively continuing with the next one until the cycle is completed and starts again, as shown in the following illustration, and the iterative spiral that it represents. In this way, we will develop all the main aspects of the initiative at the same time and taking into account the progress of all the axes in an integrated way.

The eight axes of the Purpose Launchpad are the main elements that we must develop in an innovative initiative with impact. They are described briefly below:

- **Purpose:** The reason why our initiative exists.

- **People:** This refers to both the internal team and the communities of people with whom we connect to facilitate the development of our initiative.
- **Customer:** The people or entities to which we offer a product or service based on a specific need.
- **Sustainability:** We will need to achieve triple sustainability, in economic, environmental, and social terms.
- **Abundance:** It will be necessary to define how we connect and how we manage abundance, which will allow us to have exponential growth.
- **Processes:** Ideas are worth nothing; it is the execution that matters. We implement agile methodologies and the necessary processes to execute the initiative in the correct way.
- **Product:** It will also be necessary to define the value proposition and eventually develop the right product for the market.
- **Metrics:** It is useless for us to act if we do not measure to learn continuously, so we will have to implement different accounting systems: financial, innovation and impact.

To work on and develop each of the above axes, Purpose Launchpad recommends a series of innovation methodologies and tools that we will see in the next section.

Returning to the definition of the initial Purpose Launchpad, it is important to remember that it mentioned that it attempts to "*help people to act with the right mindset*" and, for this, it will be essential to take into account the moment in which the project is, since each stage will require acting with a different mindset. To do this, Purpose Launchpad defines three phases of maturity in which an initiative can be found, and which will mark the way in which it can be managed:

- **Exploration:** In the beginning, we do not even know what we do not know and we need to discover different possibilities for each of the key aspects of our initiative (who is our client, what product/service they need, who should make up the team, which metrics to measure, etc.).
- **Evaluation:** Once we discover potential ways to make our purpose a reality, we will begin to carry out experiments to evaluate which of these ways is the best to continue developing it.

- **Impact:** Once we have validated our key hypotheses, we have early adopters (initial customers) who are happy with our product/service. This is the point that we are properly connected to abundance, etc. and it is time to focus on growing our initiative and managing abundance to eventually create a massive positive impact.

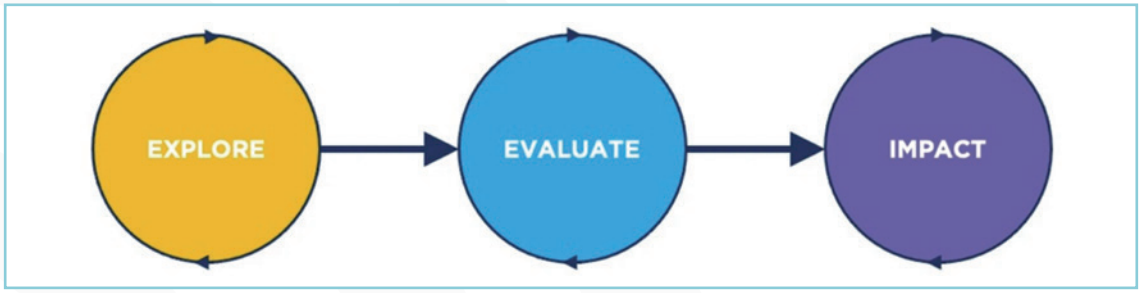

Figure 23: Management phases of an initiative in the Purpose Launchpad. Source: [53]

To find out what phase an initiative is in, as well as each of its axes, there is a tool called Purpose Launchpad Assessment[10] which, after asking a series of questions, displays the Purpose Launchpad Radar which consists of a graph that indicates the status maturity of each of the eight axes, as can be seen below:

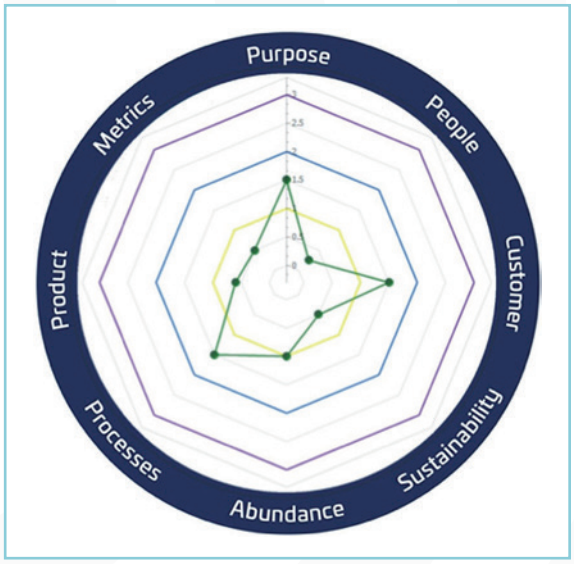

Figure 24: Results of an evaluation in the Purpose Launchpad Assessment. Source: [53]

The University Living Labs try to promote the creation of innovations with value propositions with a global positive impact on society. For this, Purpose Launchpad can be a framework that facilitates the generation and evolution of this type of proposals, thanks to the integration of the state of the art of innovation methodologies and its management through mechanisms such as the Purpose Launchpad Radar, all of which is oriented to minimize the risk inherent in innovation and maximize the impact.

10. www.purposelaunchpad.com/assessment

5.4.2 Tools for the design of positive impact value propositions

When bringing new technologies to the market, it is very common to use the TRL model or the nine levels of technological maturity which, in turn, are grouped into three phases: Research (TRL1, TRL2 and TRL3), Development (TRL4, TRL5 and TRL6) and Deploy (TRL7, TRL8 and TLR9), as shown below:

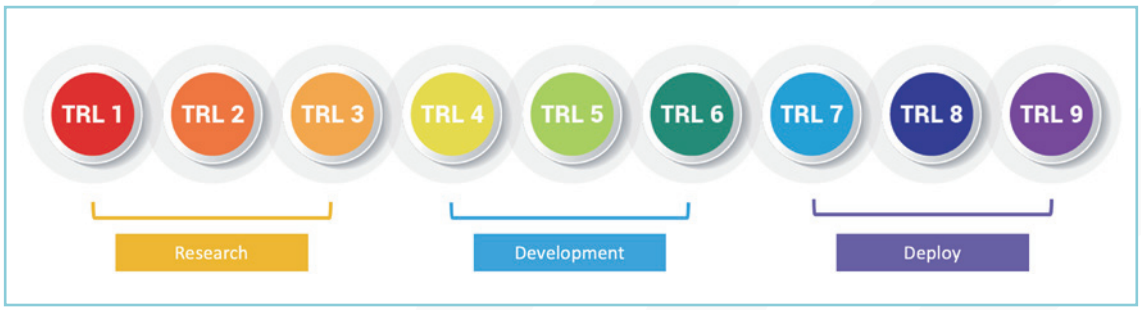

Figure 25: Stages of technological maturity in the TRL. Source: [53]

Although it is true that the TRL model has been implemented with great success by NASA when developing new technologies, it must be taken into account that, when it comes to innovating in the market and creating a positive impact on society, it is also It is very important to consider from the beginning other factors beyond the technological one. For example, as Steve Blank himself always advises: "*we must develop the client before developing the product*". In other words, it is very important to validate that there is a market opportunity, as well as to know who our potential client is (and who is not) before developing a product that does not interest anyone.

Therefore, if we were to implement TRL only initially, we would be making the mistake of creating technology without a clear business case or market. In other words, we would be *creating a solution in search of a problem*.

For this reason, our basic proposal when designing value proposals with a positive impact within the framework of the University Living Labs consists of starting by considering all kinds of elements from the beginning, not just the technological ones. This is why we recommend implementing Purpose Launchpad in parallel with TRL from the beginning, which will allow us to ask

ourselves important questions like who our client is and what their needs are. This will all guide the development of the rest of the axes, such as the product axis itself, in which we will eventually have to integrate or develop new technologies (for which TRL is followed).

In fact, the proposal responds to a natural fit, since there is an important parallelism between the three maturity phases defined by Purpose Launchpad and the three phases into which the TRL maturity levels are grouped. As shown in the image below, the Explore phase of the Purpose Launchpad corresponds to the TRL levels in the Investigate phase, where underlying hypotheses are tested; the evaluation phase of Purpose Launchpad corresponds to the TRL levels in the development phase, in which tests are carried out in controlled environments; and finally the impact phase of the Purpose Launchpad corresponds to the technology levels in the TRL phase in the implementation phase, in which the technology is applied in real environments and its use is scaled.

Taking into account that, beyond merely developing technology, applications and initiatives of value for the market and impact for society must also be developed in the Living Labs, below is a series of tables associated with the different aligned TRL phases to those of Purpose Launchpad, as well as the tools that are proposed to be used to develop the initiative at all times.

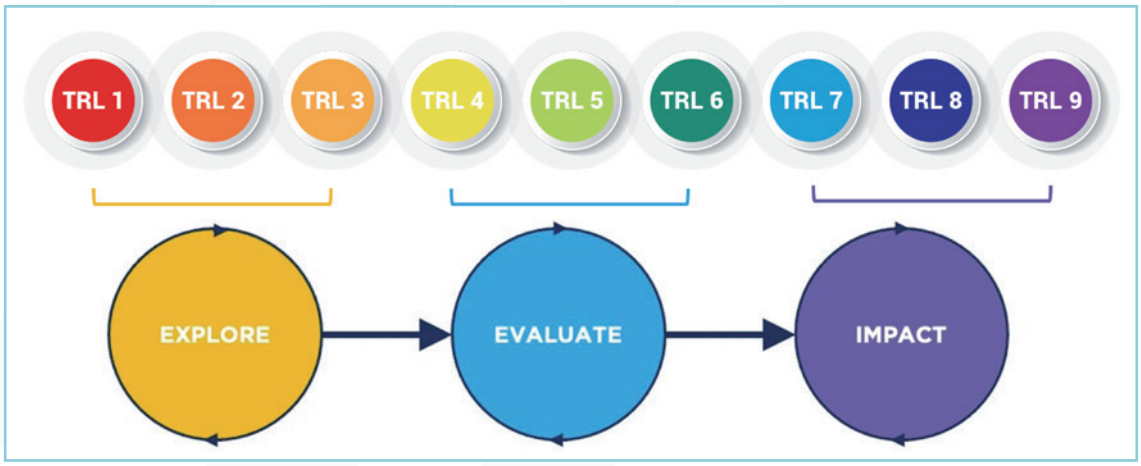

Figure 26: Relationship between TRL and the management phases of an initiative in the Purpose Launchpad. Source: [53]

Table 2: Axes of the Exploration management phase of an initiative in the Purpose Launchpad

EXPLORATION / RESEARCH - TRL1, TRL2 & TRL3		
Axis	Tool/s	Aim
Purpose	MTP Canvas	Define the purpose of the initiative
People	Empathy map Team Canvas	Find potential customer segments as well as the team
Customers	Value Proposition Canvas Customer Development	Assess the needs of customer segments
Sustainability	Business Model Canvas Basic cashflow projection	Analyse possible economically viable scenarios
Abundance	ExO Canvas	Define how to connect and manage abundance
Processes	Purpose Launchpad	To experience from the beginning
Product	Agile Development	Agile product development
Metrics	Impact Accounting Canvas	Define key metrics to measure

Source: [53]

Table 3: Axes of the Evaluation management phase of an initiative in the Purpose Launchpad

EVALUATION / DEVELOPMENT - TRL1, TRL2 & TRL3		
Axis	Tool/s	Aim
Purpose	MTP Canvas Identity Canvas	Evolve and evaluate the purpose of the initiative
People	Community Canvas	Define and evaluate possible communities of the initiative
Customers	Value Proposition Canvas Customer Development	Find first early adopters
Sustainability	Business Model Canvas Basic cashflow projection	Analyse possible economically viable scenarios
Abundance	ExO Canvas	Evaluate how to connect & manage abundance
Processes	BPMN	To give value to the first Early Adopters & learn
Product	Agile Development	Agile evolution to find product-market fit
Metrics	Impact Accounting Canvas	Define / monitor key metrics to measur

Source: [53]

Table 4: Axes of the Impact management phase of an initiative on the Purpose Launchpad

IMPACT / DEPLOY - TRL1, TRL2 & TRL3		
Axis	Tool/s	Aim
Purpose	MTP Canvas	Consolidate the purpose of the initiative
People	Community Canvas	Manage and scale potential initiative communities
Customers	Value Proposition Canvas Customer Development	Go to the majority market and scale sales
Sustainability	Business Model Canvas Basic cashflow projection	Implement financial plans and monitor them
Abundance	ExO Canvas	Scale connection and abundance management
Processes	BPMN	Optimize the delivery of value to real customers
Product	Agile Development	Continuous product improvement in an agile way
Metrics	Impact Accounting Canvas	Monitor key metrics to achieve purpose

Source: [53]

These tables can be of great help when creating and developing impact initiatives in a *Living Lab* environment. In addition, it can be complemented with the open guide of Purpose Launchpad (available for download at www.purpose-launchpad.com) and with the annex attached to this document with links to download the different tools previously mentioned. And of course, the help of a certified Purpose Launchpad mentor can make a difference when it comes to properly guiding the correct development of an impact initiative.

In any case, remember that the key to developing successful and impactful initiatives is not technology, not even tools... the key will be to act with the right mentality!

Annex

Download links for Positive Impact value proposition design tools.

Below is a list of the different resources that were presented in the 'Tools for the design of value propositions with a positive impact' section. In the official guide of Purpose Launchpad (www.purposelaunchpad.com) you will find a more complete and updated list.

Table 5: Tools for the design of value propositions with a positive impact

Axis	Tool/s	Aim
Purpose Launchpad Guide	General	https://www.purposelaunchpad.com/
Purpose Launchpad Assessment	General	https://purposealliance.org/es/recursos/purpose-launchpad-assessment/
MTP Canvas	Purpose	https://purposealliance.org/es/recursos/mtp-canvas/
Identity Canvas	Purpose	https://purposealliance.org/es/recursos/organization-identity-canvas/
Community Canvas	People	https://purposealliance.org/es/recursos/Community-canvas/
Team Canvas	People	https://purposealliance.org/es/recursos/team-canvas/
Value Proposition Canvas	Customers	https://purposealliance.org/es/recursos/Value%20Proposition%20Canvas/
Business Model Canvas	Sustainability	https://purposealliance.org/es/recursos/Business%20Model%20Canvas/
ExO Canvas	Abundance	https://purposealliance.org/es/recursos/exo%20canvas/
Plantilla BPMN	Processes	https://purposealliance.org/es/recursos/bpmn-template/
Impact Accounting Canvas	Metrics	https://purposealliance.org/es/recursos/Impact%20Accounting%20Canvas/

Source: [53]

6 CROSS-ECOSYSTEM METHODOLOGY

Guillermo del Campo (UPM) and Manuel Villa-Arrieta (Funseam)

6.1 Benefits and challenges of Cross-ecosystem innovation

The ecosystem of a university Living Lab is determined by a set of constraints (e.g., location or governance) and features (e.g., size or knowledge orientation) that affects its internal behaviour and interaction with participants.

- **Location:** Depending on the country (or even region within a country), regulations that apply to the Living Lab processes may diverge. On the other hand, a Living Lab within the downtown area will present different constraints when compared to one located in the suburbs.
- **Governance:** Although there are common regulations, public and private universities may differ in some procedures that may affect the interaction with Living Lab participants.
- **Size:** University size (both in number of students/staff, and physical facilities) will influence the scale of the Living Lab validation, including user engagement potential.
- **Knowledge orientation:** The level of engagement of campus users will be marked by the field of knowledge that is being covered: technical, science or humanities.

The gaps or deviance in ecosystems across universities result in the appearance of new challenges that make collaboration between Living Labs difficult.

Out of all the ecosystem factors, the Tr@nsnet project is focused on the analysis of how differences in country and region affect Living Lab interaction for improving existing innovations or implementing new ones.

Contemporary research and innovation (R&I) success relies on collaboration

across organizations, disciplines, and regions [56]. International R&I collaboration is associated with higher quality standards, providing multiple benefits such as conducting comparative analysis, learning from each other or access to external knowledge ([57] and [58]). University Living Labs are unquestionable seeds for international R&I collaboration [59]. They are made up of 4 types of stakeholders: Academia, Private Sector, Public Administration and Citizens. While the initial and most common configuration will include local participants, Living Lab growth will be open to abroad contributors, especially concerning Academia and Private Sector.

This Cross-ecosystem innovation will add new challenges to those presented in chapter 3 (Governance Model):

- **National/regional/local regulations:** Although universities have certain level of autonomy, they still have to comply with national, regional and local regulations that may affect collaboration. These regulations include the installation of equipment and intellectual property of results or financing tools.
- **Cultural backgrounds:** Diverse cultural backgrounds affect not only communication, but also organizational processes and the perception of information and reality [59]. Cultural distance is likely to limit collaboration outcomes and innovation quality.
- **Technical specifications:** Technology solutions chosen need to comply choose to comply with specific technical standards (communication protocols, interfaces, power sources), which may differ across countries, regions or even universities.
- **Administrative procedures:** Differences in administrative procedures (e.g., work licences, equipment acquisition, and data protection) may result in delays or even cancellation of innovation collaboration.
- **User engagement:** Campus users (students, teachers, searchers, and staff) represent the role of Citizens at the university Living Labs. Campus user engagement with the Living Lab relies on the campus governance (level of compromise) and ecosystem (teaching-research-innovation helix).

6.2 Cross-ecosystem innovation in Tr@nsnet project

Transnet project international R&I collaboration in the framework of university Living Labs has taken two paths: the replication of existing solutions or components (TG1) and the implementation of new systems or elements (TG2). The common goals of TG1 and TG2 are:

- To capitalize on the experience and the lessons learned by the demonstrator's cross-transfer between universities in France, Spain and Portugal: Identify technical and non-technical barriers and propose solutions to overcome them.
- To collaborate with technology providers (companies) that will appreciate the service and advice offered by the labs in their system.

To study how end-users perceive the systems and what the benefits are in order to explain the acceptability of each technology by different cultures and type of user (education, technical background, environment awareness, etc.)

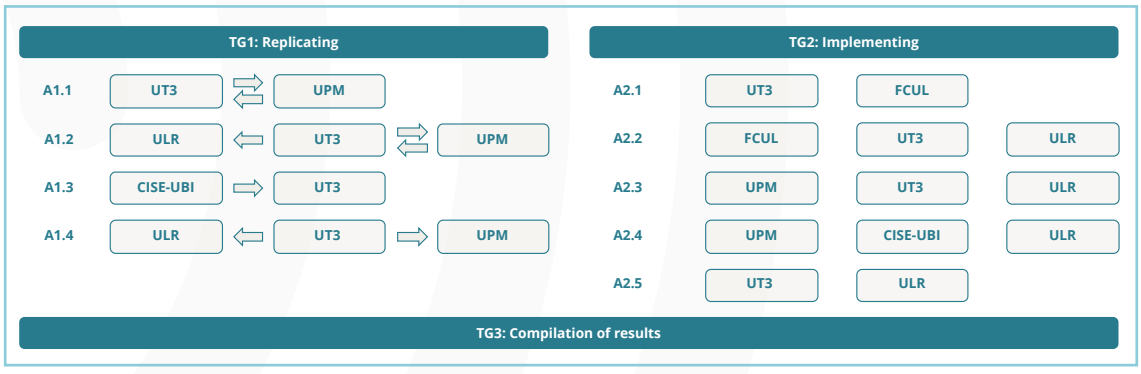

Figure 27: Participant connection in Tr@nsnet regarding Cross-ecosystem collaboration. Universities collaborate in the replication (TG1) and implementation (TG2) of innovations. Funseam compiles and analyses the process of international collaboration.

6.2.1 TG1. Replicating Innovations

The objective of TG1 is to study the processes of adaptation and transfer of a Demonstrator from one environment to another in order to capitalize on the

definition of good practices and methods that will be memorized in TG3. We offer to reproduce the demonstrators/experiments developed within one university in another university. In this section, the goals and results of each activity are summarized. TG1 is divided in four activities:

- **Replication of intelligent lighting devices (UT3, UPM)**
  Hypothesis: UPM and UT3 replicate existing Smart street lighting solutions.
  Results:
  – UPM has replicated the Kawantech solution from the UT3 campus, deploying Kara systems and integrating them with existing BatStreetlighting solution.
  – Meanwhile, UT3 has replicated the T6000 solution from the UPM campus, deploying BatStreetlighting and BatLink devices.

- **Home automation (IoT) in the Gateway Network building (UT3, UPM, ULR)**
  Hypothesis: UPM, ULR and UT3 replicate existing IoT solutions for building automation.
  Results:
  – UPM has replicated the Neosensor solution from the UT3 campus, deploying and integrating IoT ambient sensors.
  – UT3 has replicated the T6000 solution from the UPM campus, installing and integrating IoT ambient and Smart meter sensors.
  – ULR has replicated the Neosensor solution from the UT3 campus.

- **Coupling electrical and thermal power generation (UT3, CISE-UBI)**
  Hypothesis: UT3 and CISE-UBI replicate existing electrical-thermal power solutions.
  Results:
  – UT3 has replicated a combined PV and thermal installation located at CISE-UBI on a small-scale.

- **Use of digital technology on campuses, service needs in terms of services. Shared analysis. (UT3, UPM, ULR)**
  Hypothesis: UPM and ULR replicate existing survey by UT3.

Results:

- UPM has replicated the previous survey conducted in the UT3 campus.

6.2.2 TG2. Implementing innovations

The aim of TG2 is to design and implement new demonstrators in universities in order to acquire skills, collaborate and exchange methods and ways of working in each university. The capitalization of these experiences makes it possible to enrich the definition and specification of University Living Labs. Each demonstrator will constitute a real platform-like environment with an inter-sectorial approach. TG2 is divided in five activities:

- **Recycling batteries for solar energy storage (FCUL, UT3)**
  Hypothesis: FCUL and UT3 will implement new demonstrators based on the re-utilization of spend batteries.
  Results:
  - FCUL has deployed a mini-grid with PV modules and second-life batteries coming from electric vehicles. This grid will power the students' rooms.
  - UT3 has deployed a micro-grid with PV modules and batteries coming from golf trolleys. This grid will power the charging of electric bikes.

- **Mobility observation (FCUL/ULR/UT3)**
  Hypothesis: FCUL and UT3 will characterize the mobility behaviour of campus users.
  Results:
  - FCUL has conducted a mobility survey and installed sensors for counting the mobility modes.
  - UT3 has carried out a mobility study and installed sensors, radars, and measurement nodes across the campus.

- **Environmental interactions with human activities (UPM, UT3)**
  Hypothesis: UPM will analyse the impact of users in campus wildlife. UT3 will study the impact of a natural water filter in campus environment.
  Results:

- UPM has deployed bio-acoustic sensors and camera traps to collect wildlife data (for birds, bats, and mammals), and has analysed the effect of user activity (transport, works, artificial lighting).
- UT3 has developed and installed water filters based on nature-like solutions and has analysed the social and ecological impact.

- **Integration of electrical and thermal networks (CISE-UBI. UPM)**
  Hypothesis: CISE-UBI and UPM will implement systems integrating electrical and thermal networks.
  Results:
  - UPM has deployed a hybrid PV-aerothermal solution to power HVAC systems.
  - CISE-UBI has simulated and carried out experimental studies for the integration of renewable energy technologies, integrating different loads and storage technologies.

- **Social interactions, eco-citizens (ULR, UT3)**
  Hypothesis: ULR and UT3 will implement innovations to increase citizen awareness of sustainability.
  Results:
  - UT3 has developed and installed "Nacelle", an innovative space aimed at increasing social collaboration in the framework of energy consumption.
  - ULR has been trained in the use of Nacelle and participated in different sessions.

6.2.3 Lessons learned from TG1 and TG2

In general terms, results are in line with the initial hypothesis of the activities from TG1 and TG2. However, there are same cases in which either one of the universities has not been able to replicate/implement the innovation or they have to overcome unpredicted issues. Lessons learned from the process and outcomes aim to complement the ENoLL Living Lab model with a guidelines/model to help future adopters of Living Labs ecosystems taking into account the cross-ecosystem collaboration.

6.3 Identification of challenges and user experience

Funseam has conducted a survey to collect data from tasks developed by the universities in TG1 and TG2. The questionnaire is very simple (3 questions), asking for information about the technical difficulties, the administrative difficulties and how the campus users have evaluated the replication/implementation on innovation.

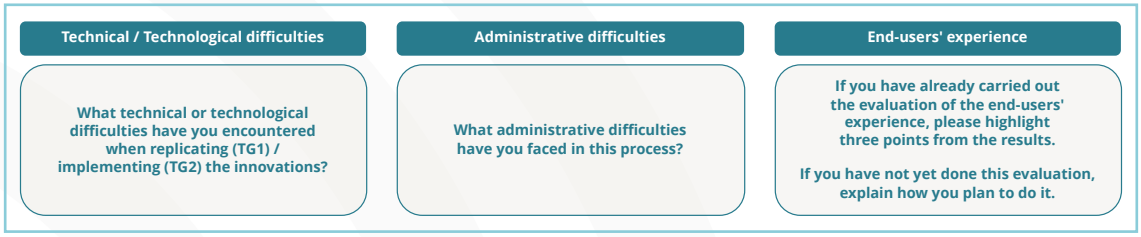

Figure 28: Survey questions to collect data on the tasks developed by the universities in TG1 and TG2 in the Tr@nsnet project.

There have 25 answers (12 for participants in TG1 and 13 for those in TG2). Notice that the survey was conducted in October 2022, with a 5-month leeway to finalize the project activities. Therefore, end-users' experience may be on-going or planned.

Regarding the replication of innovations (TG1), five participants report technological or technical difficulties, such and the configuration of devices or integration with existing platforms. More participants (7) account for administrative difficulties, including both university internal protocols and wrong procedures. As for the end-users' experience, just four of the respondents have asked campus users, either with online surveys or via a mobile app.

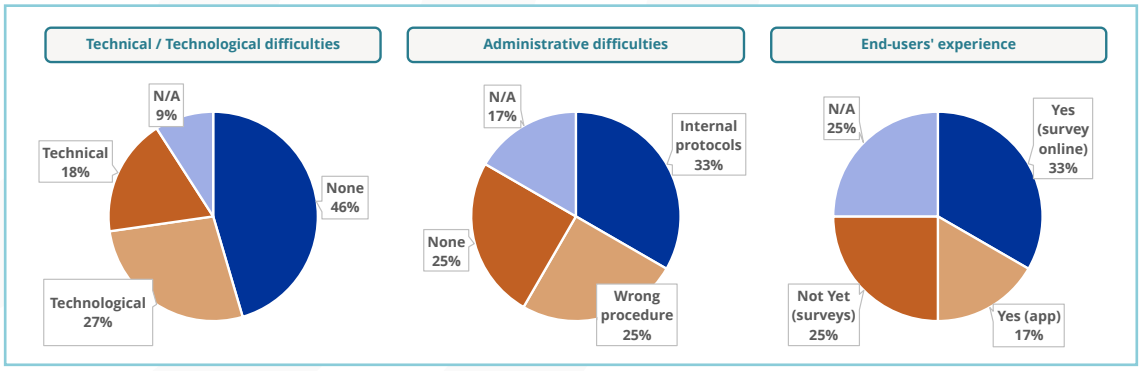

Figure 29: Replicating Innovations (TG1) overall results.

Regarding the implementation of innovations (TG2), ten participants report technological or technical difficulties, mainly because of a poor initial design of the lack of components in the market. The same number of participants (10) account for administrative difficulties, including both university internal protocols and lack of planning. As for the end-users' experience, just seven of the respondents have asked campus users, either with online surveys or via a mobile app.

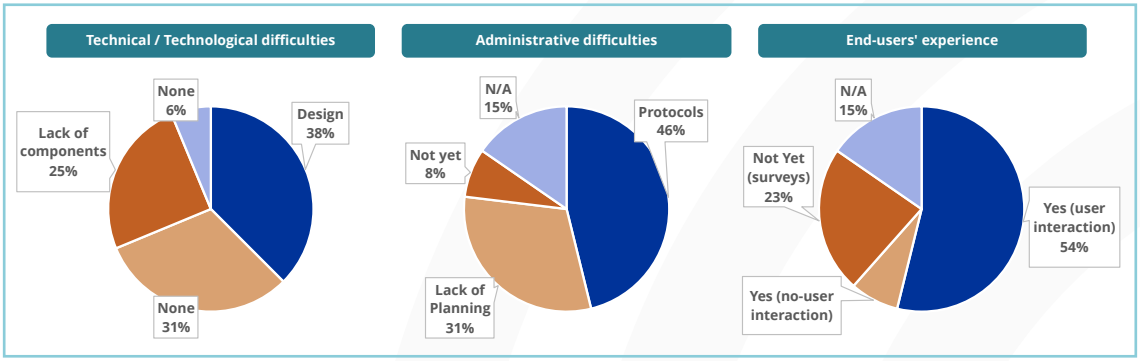

Figure 30: Implementing Innovations (TG2) overall results.

6.4 Methodology for (cross-ecosystem) replication and implementation of innovations

The collaboration between Living Labs of different university ecosystems entails several challenges, but it also provides new opportunities to solve the difficulties that arose during the replication and implementation of innovations.

In this section, we will provide a practical model for the cross-ecosystem collaboration, namely the definition of the most relevant elements, their interactions, the roadmap, the most common complications, and the methodology to solve them.

- The goals of the innovation (common and particular).
- Participants and their interaction.
- Draft solution (components and steps).
- Difficulties (during the development and deployment).
- Collaborative solution (Feedback and replication).

We propose to converge these aspects in a new Cross-ecosystem Methodology Canvas. This Canvas is a dynamic tool that helps Living Labs to have clear view on how to handle the appearance of difficulties in the process of replication and implementation of innovations in collaborative ecosystems across universities. The Canvas should be filled in a constructive and collaborative way among Living Labs sharing the cross-ecosystem innovation. Figure 31 presents the draft version of this Canvas used in the framework of the Tr@nsnet project. As future work, we are planning a version of this Canvas to include new variables and new aspects to be taken into account in the replication and implementation processes of cross-ecosystem innovations.

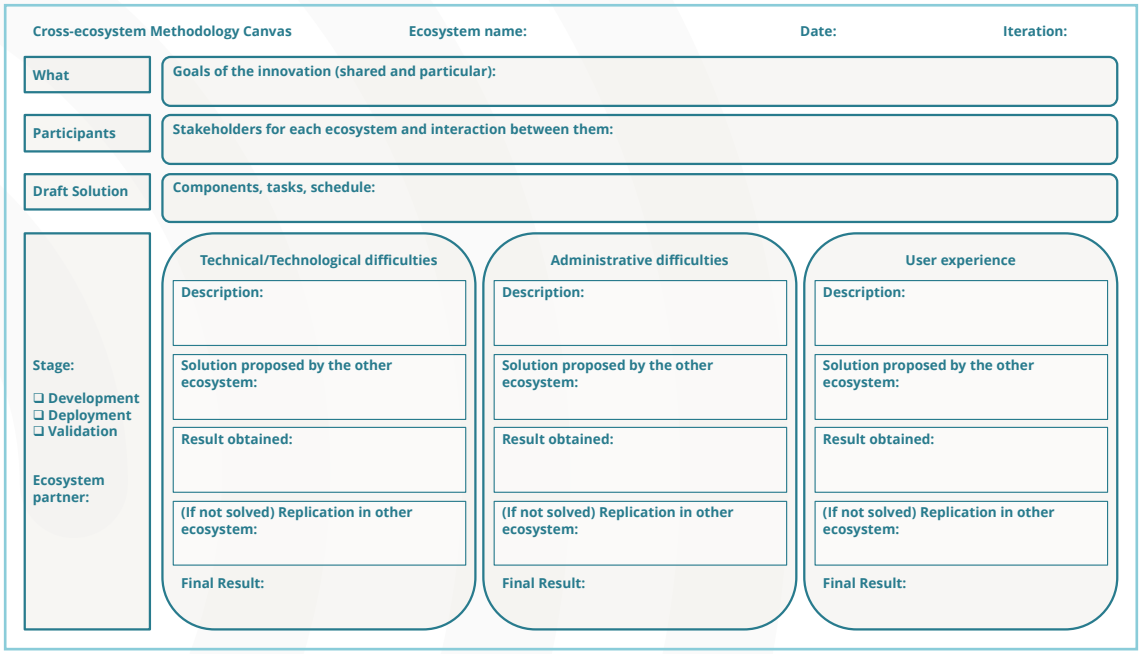

Figure 31: Cross-ecosystem Methodology Canvas.

In the following paragraphs, the content of each section will be explained. We illustrate the Canvas model completion with a practical example extracted from the Tr@nsnet project: Activity 1.1 Replication of intelligent lighting devices.

The goals of the innovations

This section should summarize the common goal of the innovation: e.g., the replication of an IoT technology for lowering energy consumption in university buildings or the implementation of social awareness tools to engage

campus users in the use of public transport). However, the model should also include the specific objectives from each Living Lab: e.g., the validation of a research result or the participation of local communities.

Example:

- *Common goal: Replication of existing Smart street lighting solutions.*
- *Specific goal from UPM (Spain): integration of research developments with commercial solutions.*
- *Specific goal from UT3 (France): user experience validation of Smart street lighting solutions.*

Participants

This block should list which stakeholders from each Living Lab ecosystem are taking part: e.g., faculty, research group, maintenance staff, industrial parties, campus users or neighbour citizens. Additionally, it should define the interaction among them, including intra-ecosystem (e.g., researchers and maintenance staff for the deployment of innovations) and cross-ecosystem (e.g., university administrative office and industry for the acquisition of equipment).

Example:

- *Participants:*
  - *UPM ecosystem: CEDINT R&D centre, Campus maintenance staff, University Administrative Office, Tecnica 6000.*
  - *UT3 ecosystem: Laplace Laboratory, Campus maintenance staff, University Administrative Office, Kawantech.*
- *Interaction:*
  - *Tecnica 6000 is a Spanish company that acts a technology provider for the technical solution deployed at the UPM campus.*
  - *Kawantech is a French company that acts a technology provider for the technical solution deployed at the UT3 campus.*
  - *UT3 (Laplace) has to acquire the solution from T6000 to replicate it.*
  - *UPM (CEDINT) has to acquire the solution from Kawantech to replicate it.*
  - *T6000 has to comply with French procedures with the guidance of UT3 Administrative Office, and with the technical constraints of the existing solution at UT3 campus.*

- *Kawantech has to comply with Spanish procedures with the guidance of UT3 Administrative Office, and with the technical constraints of the existing solution at UPM campus.*
- *Laplace laboratory has to agree with UT3 Campus maintenance about the deployment of the replication.*
- *CEDINT has to agree with UPM Campus maintenance about the deployment of the replication.*

Draft solution

Within the section, the design of the innovation development and deployment must be planned. On one hand, we should determine the required components (e.g., communications devices, software platform or physical infrastructures. Then, the necessary steps towards the innovation development and deployment should be calendared, including a schedule and milestones.

Example:
For replication in UPM:

- *Components:*
  - *Camera Sensor from Kawantech. Existing streetlights and dimming controllers in UPM. Power source and Internet connection for Kawantech solution.*
- *Steps:*
  - *Acquisition of Kawantech solution.*
  - *Testing in laboratory environment.*
  - *Integration with existing streetlights and IoT solution.*
  - *Real deployment.*
  - *User validation.*

For replication in UT3:

- *Components:*
  - *IoT devices from T6000, new LED luminaires with interface for the IoT devices, new poles for the integration of the new luminaires and the IoT devices.*
- *Steps:*
  - *Acquisition of T6000 solution.*
  - *Testing in laboratory environment.*

- *Integration with new LED luminaires.*
- *Integration with existing solution.*
- *Real deployment.*
- *User validation.*

Difficulties raised during the development and deployment of the innovation During the development and deployment phases, different issues may appear, preventing the successful replication or implementation of the innovation. These difficulties can be divided into three categories: technical, administrative and user engagement.

The technical difficulties include issues related to the incompatibility of interfaces, power sources, communication protocols, software versions, operative systems, or environment, among others.

The administrative difficulties are caused by the differences between public procedures and regulations, including those for acquisition of goods and the installation and maintenance responsibilities.

Engaging campus users for the validation and enrichment of the Living Labs innovations is a complex task. Campus users (not only students but also teachers, researchers, and staff) do not tend to participate in an initiative unless they are highly interested in the topic or receive some kind of incentive.

This section brings together the difficulties for each category.

Example:

- *Technical difficulties:*
  - *UPM has problems connecting the Kawantech Camera to the Internet.*
  - *T6000 has to adapt the solution to be able to interact with the UT3 platform.*
- *Administrative difficulties:*
  - *Processes for the acquisition of equipment are very slow and tedious, delaying the next steps.*
  - *UT3 has to comply with strict regulations for installing new streetlights.*

- *User engagement difficulties:*
  - *UPM has not managed to engage campus user in innovation validation.*

Collaborative solution

One of the benefits of the cross-ecosystem towards innovation in Living Labs is the capacity to overcome difficulties in a collaborative way. The Cross-ecosystem Model Canvas proposes a two-step problem-solving methodology based on both knowledge (previous experience) and experimentation (replication).

When a Living Lab faces a new problem, it may be similar to one that has already been encountered in other Living Labs. Therefore, the first step is to ask fellow counterparts for feedback on how to proceed.

If there is not such knowledge or the problem persists after implementing the recommended solution, we should go on to the following step.

This step consists of the replication of the problem/issue in other Living Lab ecosystems. By reproducing the innovation but with different constrains from each ecosystem, it will be easier to identify the origin of the difficulties, and as a result, find a successful solution.

Example:

- *UPM is not able to engage campus users in the validation of the streetlight innovation.*
- *UPM asks UT3 for feedback.*
- *UT3 recommends UPM to launch an online survey.*
- *UPM launch the survey and while the level of engagement increases, it is still low.*
- *UPM replicates the system in UT3.*
- *UT3 identifies that the visibility of the system needs to be improved (e.g., by installing information panels in university buildings).*

7 REGULATORY SANDBOX

Joan Batalla-Bejerano and Manuel Villa-Arrieta (Funseam)

Excerpt from the Tr@nsnet report "Energy Transition and Regulatory Sandboxes" [1]

7.1 Regulatory Sandboxes to drive the Energy Transition

In the Energy Transition regulatory innovation is essential in order to bring together the benefits of new technological advances with the requirements of the market and society, and thus protect consumer rights. In order to decarbonize our economy, it is necessary for innovative processes to be carried out in a way that creates harmony between the regulatory, technological and business spheres. However, technological innovation and regulatory innovation have different rates of growth and have therefore been addressed at different stages of the global innovation process, with regulation normally lagging behind technological innovations (Case 1 in Figure 32).

The imbalance between technological and regulatory development does not mean that the latter is not comparable to the former. Regulatory frameworks in the market economy seek to create opportunities so that new business models or technical and technological innovations help solve or advance the country or regional objectives. A clear example of this in the context of the energy transition is the *Clean energy for all Europeans package*, approved in 2019 by the European Union after more than three years of debate and discussion. Regulation can also be anticipated by creating regulatory frameworks that facilitate the adoption of technological innovations and new business models that make it possible to achieve global objectives. However, regulation has traditionally been seen as a barrier for innovators, who consider it an administrative burden that increases market entry costs (Case 2 in Figure 32).

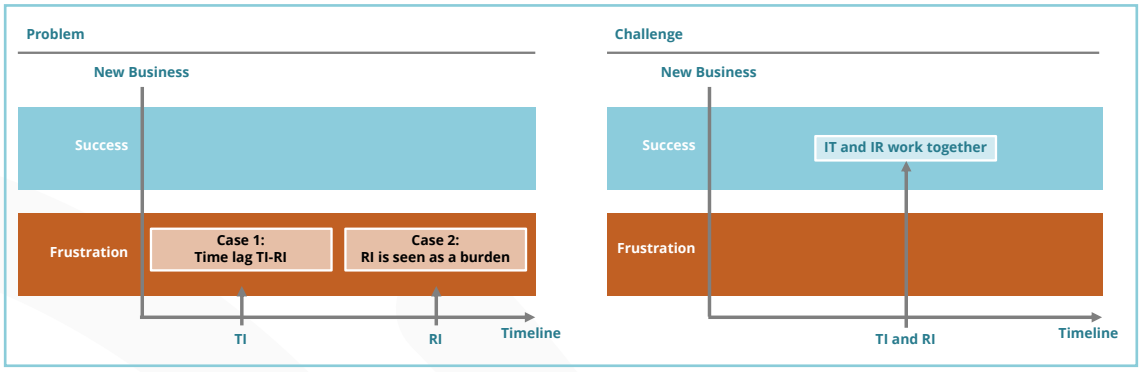

Figure 32: Technological Innovation (TI) and Regulatory Innovation (RI). Source: [1]

The energy transition does not have a single set path that will lead to the decarbonization of the economy, but it is necessary to do it in such a way that the negative impact for all actors involved is limited. There are multiple challenges, each with their own particularities depending on the geographical area and the energy sector in question. In the specific case of electricity, in terms of the decentralization and flexibility of the system, the aim is to carry out an effective and efficient adjustment of the variability of demand with the variability of the (main) renewable energy resources, which ties in with the aims of the Smart concept.

To order to respond to the need for a permanent balance between supply and demand that characterizes the operation of all electrical systems, as well as climate challenges, there are different solutions that include energy efficiency, electrification, energy storage, carbon capture and utilisation and the use of other energy types such as natural gas and hydrogen. This occurs in a context where, along with digitization and new information technologies, new activities and business models arise that cross the limits of the sector itself. Moreover, new economic agents, such as the aggregator and the prosumer and consumer empowerment are necessary, as is facing new regulatory challenges in terms of data, privacy, security, and flexibility of the same regulation [60].

Ultimately, for the energy transition, policies on energy and innovation must be orchestrated with complementary actions that serve as a multisectoral link and allow feedback between stakeholders. And this is where reg-

ulatory sandboxes come into play because they are tools that are considered to be facilitators of innovation in the same way that *Innovation Hubs* [61] are.

Given the requirements of the energy transition, among the benefits that could be achieved by using *Energy Regulatory Sandboxes* (ERS) in the energy field is its impact on company innovation. Innovation happens faster when companies can test new ideas in controlled and limited environments, and therefore minimize risk. At the same time, consumers benefit because new and useful technological products can be brought to the market sooner, having been tested previously. Direct communication between developers, companies and regulators creates a more cohesive and supportive industry. Successive trial and error within a controlled environment mitigates risks and unintended consequences, such as unseen security flaws when a new technology is accepted by the market too quickly.

In addition to promoting energy innovation, by using ERS, regulators seek, can understand, and learn how to improve regulation to face the challenges that lie ahead thanks to the flexible nature of electricity networks operation. In short, these test environments are an instrument to support innovation to overcome regulatory barriers in the energy transition. The FinTech sector has experience in using this but since it is only starting to be used in the energy sector, the current task is to study the projects that have already been put into practice.

Technically, sandboxes serve to facilitate testing and the implementation of innovations on a small scale for a limited time, in a "real" and controlled environment similar to that of the market [62]. Due to their characteristics, they offer companies and industries overall new opportunities to accelerate the use of knowledge, data and technology shared between sectors and clients. They can provide a forum for the participation and observation of start-ups, institutions, and innovative ecosystem players in a secure off-market environment [63]. This is an environment in which the regulations are kept up-to-date so as not to fall by the wayside in relation to technological advances. In

this regard, regulatory sandboxes can be seen as a support for innovation offered by regulation.

Faced with the problem of the gap between technological innovation and regulatory innovation (because disruptive technologies and associated new business models do not comply with current rules and regulations), regulatory sandboxes bring together a series of clauses that allow innovations to be tested, making application of the current rules more flexible. Experimentation clauses and exemptions are the main tools that can be used to open the legal framework to innovations and allow the use of regulatory sandboxes [60]. On the other hand, faced with the problem of the poor perception that innovators have of regulation, regulatory sandboxes include governance mechanisms and/or the leadership of an organization with a supranational mandate that allow the multisectoral and multidisciplinary nature of the innovations required by the energy transition to coordinate different actors and regulatory agents [62].

In a real environment innovative business models may encounter difficulties when trying to adapt to the current regulatory framework because these innovations had not been previously imagined by regulators. Furthermore, in the absence of coordinated action towards a common goal between the regulator, innovators and consumers, these stakeholders cannot receive the benefits of these innovations. With an ERS (see Figure 33), the real environment becomes a controlled environment with limited time and space within which a multisectoral approach involving the participation of innovative actors (companies or start-ups), consumers, innovation agencies and regulators (regulatory agents) can be used to evaluate the repeal of regulations and laws and the creation of governance or function responsibility structures, such as the entry of new economic agents. The ultimate goal is that in the real environment innovations can work and regulators can *learn* to create *Smart* regulation, and that all stakeholders are able to reap the benefits of innovations. However, the use of ERS is not always the solution. In many cases, innovators are not fully aware of the regulation and the regulator can simply guide the innovator on the scope of the existing regulation on the characteristics of the innovation they intend to bring to the market.

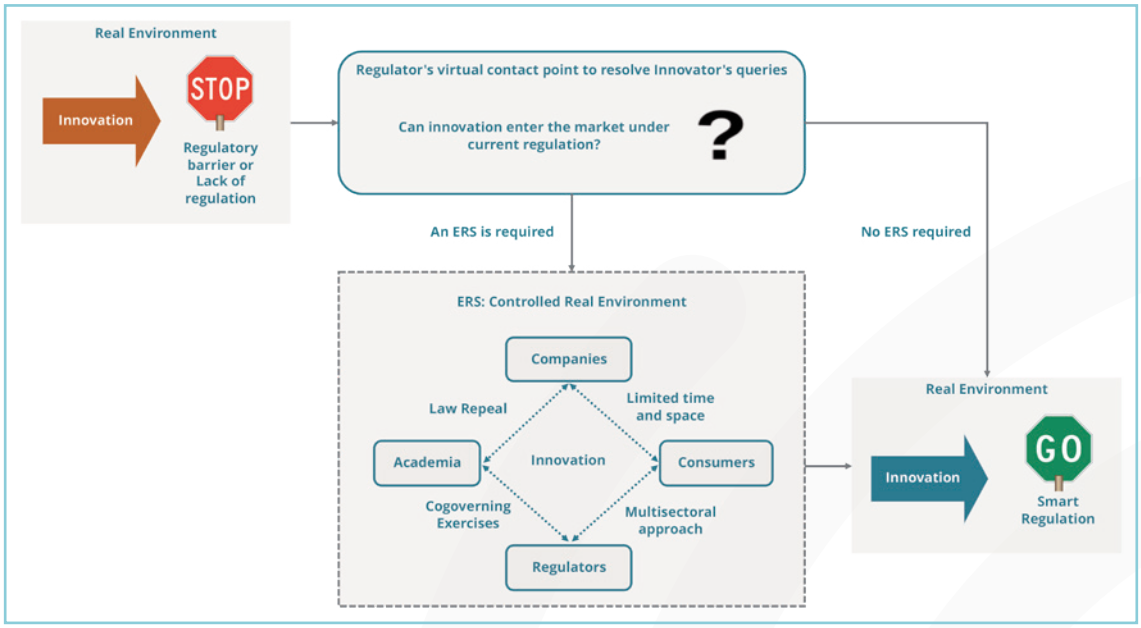

Figure 33: Application of Energy Regulatory Sandboxes (ERS) to advance regulatory innovation. Source: [1]

For the energy transition, ERS programs should focus on projects that aim to implement *Smart* solutions and are resilient to any regulatory framework so that they are capable of adapting to an uncertain technological environment that changes over time. They must address solutions that can provide overall benefits to the system by fostering innovation and lifting regulatory barriers that block solutions. The creation and financing of these programs can be launched with research and innovation instruments in which legislative measures are tested with experimental clauses that serve as the basis for a new energy policy [64]. Thus, the involvement of regulators is key in that they must be involved in enabling regulatory sandboxes from the outset and have an active role in fostering innovation towards more sustainable energy systems.

Also, learning is just as important as experimentation in ERS. For innovators who perceive regulatory barriers, the review of a project proposal by experts from regulatory bodies is extremely valuable in the event that a regulatory derogation is necessary. Furthermore, learning among innovators can be enhanced if trusted knowledge exchanges between competitors are organized [62]. Competition between the innovating parties is crucial to achieve greater acceptance by consumers. For regulators and legislators, testing in regulato-

ry sandboxes provides valuable evidence to help understand if and how regulation should change permanently.

In light of all the advantages of regulatory sandboxes, it must be pointed out that a fundamentally different regulatory framework where the rules can be deactivated, adapted or replaced as desired, is not created within these test environments. Ultimately, innovations supported by sandboxes must be able to operate within existing, albeit modified, sectoral and regulatory frameworks [64]. The most far-reaching and detailed modification of the regulation follows the administrative procedures of each country.

From a global point of view, the main objective is to achieve Smart regulation. Nowadays, the improvement of regulation as a public policy to be applied in all its interventions is considered an essential tool to be developed and implemented by all Administrations. In the case of the energy sector, continuing to move towards a better one is essential given the magnitude of the requirements that any decarbonization process of our economy entails. These are challenges to which it is possible to respond by implementing regulatory sandboxes and seeing unquestionable benefits, as shown in Table 6 below.

Table 6: Energy transition and regulatory sandboxes.

Requirements for energy transition	Solution provided by regulatory sandboxes	Benefits
• Regulatory flexibility in test environments • Validation of multisectoral and multidisciplinary scope • Consumer empowerment, not only as an aim but also as an actor for feedback on their new needs • Regulator accompaniment • Governing mechanisms for actors involved in test environments	• Creation of a safe space for emerging technologies and new models of associated business • Including safeguards for markets and consumers • A monosectoral and multisectoral focus • Role of active regulator and/or coordinator as a facilitator	• Innovation happens faster when companies can test new ideas without overhead costs, such as compliance and comprehensive protection of consumer interests • It is better to test innovation in a live environment with real consumers • The test increases innovator access to capital • Consumers benefit because new and useful technology arrive to the market more quickly • Direct communication between developers, companies and regulators creates a more cohesive and supportive industry

Requirements for energy transition	Solution provided by regulatory sandboxes	Benefits
• Innovator protection • Integration of innovation agencies • Simplification of administrative procedures	• Establishing feedback mechanisms between innovators, consumers and regulators	• Successive trial and error tests within a controlled environment mitigate risks and unintended consequences, such as unseen security flaws when a new technology is accepted by the market too quickly

Source: [1]

7.2 How to design a regulatory sandbox for the energy sector

In recent years, regulatory sandboxes have seen significant growth, mainly in the FinTech sector, and more specifically in Blockchain technology. Similarly, in the energy sector, in order to drive the energy transition forward, there have been recommendations to design and apply these experimentational environments. In July 2019, the German *Federal Ministry for Economic Affairs and Energy* (BMWi) published the document *Making space for innovation – The handbook for regulatory sandboxes* [60], and in August 2020, the British regulator Ofgem published the document *Energy Regulation Sandbox: Guidance for innovators* [64]. These are without doubt key reference documents regarding the design of this type of tool.

Although the regulation responds to the individual characteristics of each country, meaning that the regulatory sandboxes must be adapted to each national regulatory framework, these test environments have several phases in common. Figure 26 identifies these phases and the actions carried out by the two main agents: the regulator and the innovator. The latter refers to companies or start-ups that seek to introduce an innovative product in the market, be it a disruptive technology or a business model that encounters barriers in the current regulatory framework.

In the definition of this type of tools, it is necessary for their design to respond in relation to the desired objectives. Regarding this fundamental

point, the program developed by Ofgem itself offers different tools that vary depending on the specific needs of the innovation. In this sense, the British regulatory body offers *bespoke guidance* for when innovators want to try a new proposal but are not sure how the current regulation would apply. It has a "Comfort" tool for when innovators are concerned about non-compliance with the current regulation and the subsequent consequences, a "Confirmation" tool for when they need to assure clients and investors that the proposals are permitted to enter the market and a "Derogation" tool for when they have identified a rule that they cannot comply with.

Once the objectives have been defined, the process of planning and executing the regulatory sandbox itself is important. A series of requirements for before and after starting the test is outlined in Figure 26 and presents in a very synthetic way the phases that must be considered during the design phase. There are many issues that need to be addressed in each of these phases. Below, in addition to exploring each one in depth, other relevant issues that can be of use to innovators when defining their application in a regulatory test environment are highlighted. The partial or total application in these phases depends on the type of tool that the regulator offers for each innovation. The positive confirmation that the regulator can give an innovator on the viability of their innovation within the current regulatory framework will avoid performing the tests within a controlled environment. Likewise, the temporal scope of these phases is determined by milestones that inform decisions regarding the operation of the innovations in the real environment.

In a stage prior to beginning the phases described below, the regulator requests participation through open calls in order to study the current regulation regarding ERS. In Phase 1, the innovators present their proposals for participation and demonstrate that their innovations are in line with the objectives of the energy transition and reflect the regulatory problems or the barriers that exist to reach the market from institutional agents. In Phase 2 the regulator decides if the innovators' proposal is eligible. In Phase 3, the

innovators and regulators specify the regulatory sandbox by defining the derogations, the start date and the duration. In Phase 4, the tests begin. In this phase, it is important to define their duration as this prevents the risks of working outside the repealed regulatory framework. Phase 5 is a feedback period between the regulator and the innovator during the execution of the test. Phase 6 is the end of the testing period and the beginning of validation, review and analysis of results so that the innovator is able to determine if special licenses for operation and/or the Smart regulation design can be granted.

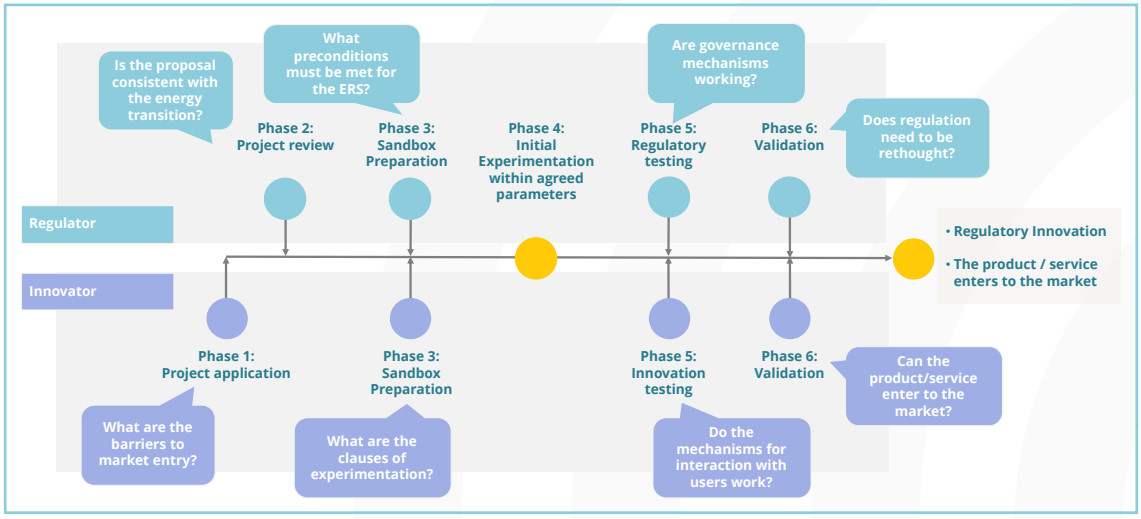

Figure 34: Application phases of an Energy Regulatory Sandbox (ERS). Source: [1]

7.2.1 Phase 1: Presentation of the proposal – Action of the innovator

The innovators submit their application to the ERS by presenting the evaluation of the commercial feasibility of the innovations, the legal and regulatory risks and the possible measures of their mitigation. According to BMWi, it is important to define goals and develop measurement indicators at this stage and ensure the participation of other interested parties by connecting with innovation networks or business networks. Innovators must also plan the time and resources to be used and specify sources of funding for the test environment. For this phase, BMWi recommends innovators ask themselves the questions in Table 7 below in order to help them refine their application to a regulatory sandbox.

Table 7: Initial phase of application of a regulatory sandbox in the energy field (ERS).

Stage	Questions to answer
• Formulating goals and developing indicators	• "What are the key objectives of the ERS?" • "What does the project want to find out?" • "How can objective achievement be measured?"
• Making sure stakeholders are on board	• "Which stakeholders are responsible for implementation, overseeing and direction? In other words, who are the main stakeholders?" • "Which stakeholders will play an active role in the implementation?" • "Which stakeholders should be involved from time to time to improve the preconditions for the ERS?" • "Which stakeholders in the environment surrounding the ERS could influence the sandbox?" • "What are the different interests that exist regarding the ERS?"
• Designing and using networks	• "Are there already networks that could be persuaded to participate?" • "How can relevant participants be brought together in a network?" • "How will cooperation be organized within the network?" • "Can network structures from other regions or projects be transferred to the ERS?"
• Planning time and resources	• "In what periods should the ERS be prepared, planned and implemented?" • "What resources should be allocated to the individual steps?"
• Looking for possible funds	• "Are there any ways to use public funding?"

Source: [1]

7.2.2 Phase 2: Verification of the proposal of the innovators – Action of the regulator

Once the proposals are received, the regulator must make their decisions within the framework of the requirements set out in the call for applications, including the objectives of the energy transition and the protection of consumer interests. Although innovations may potentially be attractive to consumers, it is understood that new proposals not previously considered within the current regulatory framework may put their interests at risk. The ERS must allow new products and services, but without running the risk of harming the consumer; Innovators must consider how their proposals engage consumers and manage risk, even if they are not products or services that directly reach consumers. Regulators must assess proposals by balancing the benefits and risks for all stakeholders.

If the proposals meet these parameters, merely reviewing the proposals and presenting recommendations to the innovators is the first step towards creating shared environmental, economic, and social objectives. It is important to remember that since the publication of the United Nations 2030 Agenda for sustainable development, institutions are defined as coordinating agents of change for the fulfilment of the Sustainable Development Goals (SDGs) and companies are called upon to be leading actors of sustainable growth. The regulator can analyse the participation of other administrative institutions seeking the dynamism of the energy sector for the benefit of consumers. Here, too, the regulator can make recommendations for innovators to analyse the market entry of their products without the need for a regulatory test or on access to financing mechanisms for these environments.

Table 8 presents some of the questions that regulators could ask about the proposals of the innovators in the design of an ERS in the current socioeconomic scenario of the energy transition.

Table 8: Verification phase of the proposal for an Energy Regulatory Sandbox (ERS).

Stage	Questions to answer
• Meeting application requirements	• ”Does the innovator’s proposal meet the application requirements?” • “Can the regulator grant special operating licenses without the need to carry out an ERS?”
• Support for national objectives	• “Does the proposal bring benefits to the energy transition of the country, region or city?” • “Can the proposal bring benefits to other social or environmental objectives?”
• Innovative proposal	• “Is it a new product, service, business model or methodology that is not available in the market?” • “Does the innovation align with the strategic direction of the expected changes in the energy system?”
• Benefits to consumers	• “Does the innovation have the potential to benefit the consumer?” • “Is it aimed at a specific type of consumer or in a situation of vulnerability?” • “What are the benefits for consumers?”
• Compatibility	• “Is there a clear regulatory barrier that requires a response?” • “What prevents the innovator from advancing their plans?”

Stage	Questions to answer
• Compatibility	• "What support does the innovator require and why is it not possible to progress without it?" • "Is the test proposed by the innovator a solid design?" • "Can the innovator bring their product to market without the need for an ERS test?" • "Can the regulator grant special operating licenses without the need to carry out an ERS?"
• Recommendations to the innovator	• "What recommendations could be given to the innovator to effectively facilitate the market entry of their product?"
• Formulate goals and develop indicators	• "Are the innovator's plans well-developed? Do they have clear goals and criteria for success?" • "What are the key objectives of the ERS within the institutional context?" • "What does the project want to discover?" • "How can the objective achievement be measured?"
• Design and use institutional networks	• "What is the institutional or administrative, technical, regulatory and market scope of the ERS within the framework of the energy sector?" • "Are there other administrative institutions that should be involved?" • "How can relevant participants be brought together in a network?" • "How will cooperation and governance be organized in the network?" • "Can network structures from other regions or projects be transferred to the ERS?"
• Looking for possible funds	• "Does the innovator have funds available?" • "Can innovators access public funding for innovation?"
• Exit strategy	• "Does the innovator have a clear exit strategy from the ERS?" • "Does the innovator demonstrate that the different exit routes available have been considered?"

Source: [1]

7.2.3 Phase 3: Preparation of the energy regulatory sandbox – Joint action between the regulator and the innovator

Following the regulator's proposal in Phase 2 and responding to its questions and following recommendations, Phase 3 already has the active participation of the regulator to determine each party's commitments. Legal obstacles and possible derogations that must be carried out and the repercussions that doing so may bring, mainly for consumers, are identified here as are ways to mitigate existing risks. During this phase, the tests financial support and duration are defined and measures to determine their success or failure as well as a strategic plan to complete the test are identified. It is also crucial to re-

view the actions that other external agents must carry out, such as external audits or security validation in data handling. And crucially, a plan for transition must be established after the trial period.

Following the roadmap proposed by BMWi, Table 9 y Table 10 summarize the questions that can be asked during this Phase. By answering these questions, innovators can approach regulator involvement with robust parameters that set the boundaries of sandbox implementation. Similarly, both innovators and other stakeholders in the energy transition can analyse these questions in order to answer how they can make use of the findings or achievements. Although several of these questions must be analysed beforehand, at this stage and with the help of the regulator, the innovators can prepare the legal aspects of the test and the design of the implementation.

Table 9: Preparation of legal aspects of an Energy Regulatory Sandbox (ERS).

Stage	Questions to answer
• Identification of legal obstacles	• "Which areas and which specific legal provisions are important for the implementation of the ERS?" • "What rules and regulations prevent or block the introduction of the technology or business model?"
• Identification of possible exemptions	• "What experimentation clauses or other possibilities for exemptions exist?"
• Identify the route to obtain a waiver	• "What preconditions must be met for the exemption to be used?" • "Which authorities are responsible for issuing the exemption?" • "Is there experience with the practical application of these rules elsewhere?" • "Which authority has already issued an exemption for other cases?"
• Risk coverage	• "What risks are there of the tests causing harm to users, observers and third parties?" • "Who would be responsible for this damage?" • "How can these risks be insured?"
• Compliance with state aid rules	• "Will public funding be used to support the ERS?" • "Does the support comply with State aid rules?"

Source: [1]

Given the uncertainty of defining the regulatory exemptions that can be applied, it is important to clarify that they are considered to be experimentation

clauses or recommendations for action for a public body, concession of powers to remove requirements for a public or private body to provide documentation or use certain equipment, spaces, or facilitate any technical requirement. Its duration must be clearly defined because the expiration date is a point from which the current regulation can respond again. In many cases, and in accordance with the institutional system, the jurisdictional limits must be overcome by the clauses: it is possible that the technical exemptions to the operation of energy innovations go beyond the limits of the tax agencies, and this is why the latter must be involved in the test design. It goes without saying that the requirements for exemption must comply with the legal framework. Reviewing regulation through the lens of an innovation helps the regulator identify where regulations are redundant or present undue barriers [64].

Another key uncertainty in defining the ERS is test funding. The review of these projects and programs indicates that they do not have a line of financial support that is directly related to their design. BMWi and Ofgem point out that public financing for regulatory sandboxes is determined only by mechanisms to support innovation. Innovators must ensure that they have secured the necessary investment that permits them to carry out the tests, a task related to the implementation of the product or service [64]. The international consulting firm *Ernst & Young Global Limited* [65] highlights that in the FinTech field in some countries the financial support of a banking institution is required. In the German case, BMWi highlights the importance of its energy research fund "Living Labs for the energy transition" which held 100 million euros per year between 2019 and 2022, with which project partners can test new technologies and business models in real conditions on an industrial scale and from a holistic approach.

The financing of the projects must cover not only the direct costs of carrying out the tests but also the costs of their risks. In this sense, the ERS programs suggest that the risks must be covered by the innovators. In the particular case of electric mobility, for example, in the ALEES (Autonomous Logistics Electric EntitieS for city distribution) project in Belgium, whose business

model is based on the use of autonomous electric vehicles for logistics distribution in cities, the risk coverage is the responsibility of the vehicle manufacturer [1]. However, in the case of additional charges and fees that innovators have to incur during testing, BMWi aims to reimburse innovators for this economic burden, which is the case of the German SINTEG (*Smart Energy Showcases*) program.

Table 10: Implementation design of an Energy Regulatory Sandbox.

Stage	Questions to answer
• Choose the correct duration and place	• "How long will it take to achieve the goals of the ERS?" • "Which district, town/city or rural region is best suited to answer the questions posed by the ERS researchers?" • "What area should the ERS cover?"
• Clarifying who is responsible for monitoring and evaluation	• "What need is there for supervision and direction of the ERS? Who will perform these tasks? " • "Who will evaluate the ERS?" • "What is the response to (critical) developments in the ERS?"
• Defining indicators and data sources for the evaluation	• "Which indicators are suitable metrics for achieving the objectives of the ERS, in particular with regard to the desires of the different partners to obtain specific information?" • "What data is already available or can be used?" • "What data should be collected for the evaluation?" • "What reporting requirements follow from this for ERS stakeholders?" • "What methods are appropriate?"
• Information feedback, coordination, and governance	• "What communication channels will stakeholders use?" • "How often will meetings be held?" • "How will users interact?" • "What will the scope of the coordinator be?" • "Governance of a national, international, private or public institution?"
• Making specific use of findings	• "How will the results be used?" • "How will you ensure that the legislature can learn from the ERS?"

Source: [1]

7.2.4 Phase 4: Experimentation – Joint action between the regulator and the innovator

Phase 4 is the period of experimentation in the test environment, or in other words, the performance of the tests within the agreed parameters. Here, the

innovator starts their innovation and studies its operation under controlled conditions which emulate the real environment. Here, regulator participation is active, mainly to learn about the effect, risks, scope, and scalability of regulatory derogations. The innovator must submit periodic reports of the tests based on the agreed parameters, and the other actions proposed initially must be complied with (such as hiring the auditing firm and ensuring compliance with the consumer safeguard mechanisms). The ERS are focused on coordinating the interaction of a product, technically already validated, with the regulation that protects the interests of all the parties interested in the energy transition, but it is not focused on technically "mature" the product during the experimental period. In this sense, it is recommended to consider the questions in Table 11 below in this phase as they are related to the management of test environments from the point of view of the experimental process. The answers can feed back into the previous phases.

Table 11: Management of an Energy Regulatory Sandbox (ERS).

Stage	Questions to answer
• Information feedback	• "Are the channels of communication between the regulator, the innovators and other participating parties working?" • "Is the stakeholder response time correct?"
• Governance	• "Do governance mechanisms work?"
• Interact with the user	• "Do the interaction mechanisms with users work?"
• Deviation correction	• "Is the trial long enough?" • "Are there other risks to stakeholders not identified previously?"

Source: [1]

7.2.5 Phase 5: Validation – Joint action between the regulator and the innovator

Validation implies knowing if the ERS fulfilled its goals within the framework of the objectives as described in its design and related to the energy transition. The positive or negative result of the validation does not imply the restructuring or adaptation of the regulation, meaning the decision to maintain the regulatory exemptions, replicate them or escalate them. The market

entry of the innovation does not necessarily depend on the overall result of the test, or in other words on the modification of the regulation for the effective operation of the innovation. It is possible that the result of the test of an innovative business model related to a *Smart energy technology* (networks, self-consumption, aggregation, etc.) can validate its entry into the market with the current regulation without negatively affecting the interested parties. However, special operating licenses may also be granted to innovators upon completion of the test in the ERS. Similarly, the regulator can obtain the information necessary to update the future guidelines towards a *Smart* regulation.

The objective of the tests in the sandboxes is not the tests themselves, but rather the release of the proposals to the market. However, it is also equally beneficial for an innovator to know the limits of their proposals and determine if they are not suitable for energy markets. Proving that something does not work is also an advantage for consumers. Table 12 presents some questions that can be asked in this phase.

Table 12: Validation of tests in an Energy Regulatory Sandbox (ERS).

Stage	Questions to answer
• Innovation	• "Can the innovation enter the market?" • "Are special clauses required to enter the market?"
• ERS	• "Is the ERS satisfactory for all parties?" • "Was it correctly designed to address the energy transition?" • "Do the waivers granted work?"
• Future actions	• "Can the results be replicated by other innovators, regions, institutions, etc.?" • "Should the derogations studied be extended?"

Source: [1]

CONCLUSIONS

Decarbonising the economy requires a huge breakthrough in innovation. However, although innovation continues at an unprecedented rate, innovations often require deeper and more effective validation and involve the participation of all stakeholders. As a solution to this problem, the Living Lab concept emerged in the late 1990s to address the development, testing, and improvement of innovations in real-world contexts based on user-centred research methods. Today, Living Labs have evolved into a more robust research approach, in which different disciplines are linked together to provide answers to the challenges of industrial sectors and the economy. However, there is still a long way to go in creating Living Labs which are adapted to the requirements of the Ecological Transition. This process of transversal transformation of the economy requires innovations in which the reduction of environmental and social impact, economic impact, and the protection of consumer interests are paramount. Similarly, existing Living Labs also need to be rethought in order to improve their value proposition in the new innovative environment.

Within this context, the main objective of the Tr@nsnet project was to promote innovation for the Ecological Transition by placing the Living Labs at the epicenter of this new, emerging innovation model. The starting point was the design of a Living Lab model which was applicable to university campuses and which had three general characteristics: a generic model, aimed at public and private managers of heterogeneous technological networks made up of digitization, energy, mobility, lighting, water, management of biodiversity, etc.; an open model, based on the paradigm of open innovation; and a transferable model; with the capacity for intersectoral integration between Living Labs of the public and private sectors. From this starting point, the project undertook the analysis of the degree of relationship of replication and implementation of innovations between the five universities of Spain, France and Portugal of the consortium.

Once the previous research foundations were identified, the design of the model was proposed to integrate a set of five tools which supported the qua-

druple helix model adopted by the European Network of Living Labs (ENoLL). With these tools, the model makes it possible to enhance the value proposition of university Living Labs and the innovations validated in them. The model includes aspects such as governance to ensure the economic sustainability of Living Labs, and regulatory innovation to help overcome the difficulties regulators have in trying to keep up with the growth of technological and social innovation. In addition, it includes the possibility of transferring innovation validation experiences between different innovation ecosystems within the framework of digital transformation and feedback on the response of end users to green technologies.

The correct design of the entire Living Lab as a transforming element is a crucial aspect that guarantees the success of technological, social, and regulatory innovation. With this in mind, this paper aims to contribute to the Ecological Transition by providing a qualitative advantage to the open innovation ecosystems of the Sudoe region through this new Living Lab model applicable to the area of university campuses.

University Living Labs operate as intermediaries among cities, regions, firms, third sector and research organisations as well as citizens for joint value co-creation, rapid development, or validation to scale up and speed up innovation and businesses. To accelerate this process of change, a deeper understanding of what key factors enable innovation, specially in the public universities, is required. In this process, one question that arises is, how can innovation and sustainability be integrated to maximize their advantages for universities?

The answer to this question is not simple, since a variety of factors – including support from the top-level management, tax incentives, intellectual property and legal aspects– may interfere. Innovation enablers are a relevant question that has not been specifically addressed in this study and requires further analysis and research.

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ANNEX: TECHNICAL REFERENCES

Project acronym	TR@NSNET
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