SIRENE
SOCIAL INNOVATION RESPONSIVE ENVIRONMENTS NETWORK

MANUAL FOR INNOVATION ACTORS

Social Innovation Framework on Responsive Environments

Co-funded by the European Union

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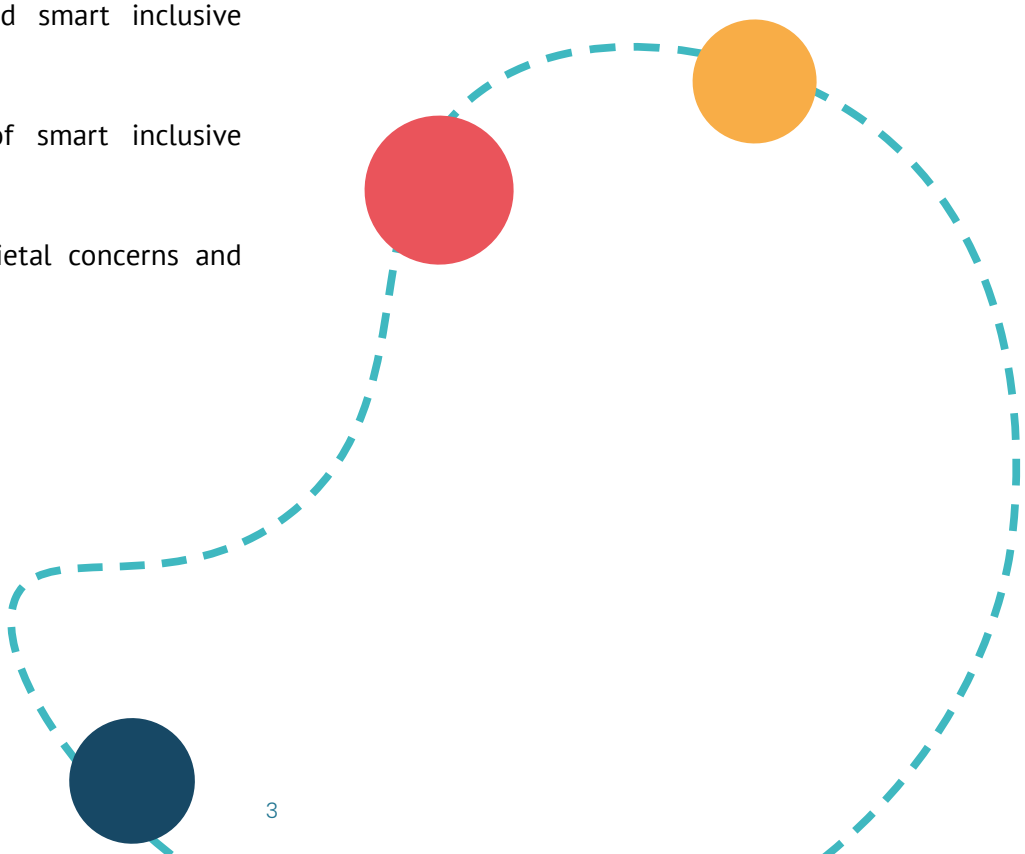
EXECUTIVE SUMMARY

The SIRENE project aims to support the growth of social innovation ecosystems delivering eco-friendly and sustainable community-based services for SHAFE (Smart Healthy Age-Friendly Environments) implementation in Europe, by providing a workable framework for investment and the broad adoption of high-quality smart living solutions, combining the housing sector and ICT infrastructure.

The manual for innovation actors introduces various concepts that are essential for understanding and conducting innovation initiatives, including social innovation. It provides explanations on responsive, eco-friendly environments and functions as a guideline for implementation of innovation and sustainbly building those environments. Hereto, it considered legal as well as ethical considerations and provides links to good practices.

In particular, the manual for innovation actors describes:

- A definition of the main concepts of innovation ecosystems.
- Key questions to analyse the local social innovation ecosystem.
- An overview of the profile of innovation actors
- An introduction of the main aspects of responsive, eco-friendly environments.
- A guideline on how to build smart inclusive environments.
- A list of impact domains of smart inclusive environments.
- An overview of data and societal concerns and potential solutions.



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1 INTRODUCTION

1.1. Background and aim

The **SIRENE project** aims to support the growth of social innovation ecosystems delivering eco-friendly and sustainable community-based services for SHAFE (Smart Healthy Age-Friendly Environments) implementation in Europe, by providing a workable framework for investment and the broad adoption of high-quality smart living solutions, combining the housing sector and ICT infrastructure.

The **manual for innovation actors** is one of the five components of the Social Innovation Framework of SIRENE. The manual focuses on the Social Innovation Framework methods and concepts, especially those with potential use for promoting responsive, inclusive and eco-friendly environments. It provides a general analysis of (social innovation) ecosystems including the needs of innovation actors, guidelines on how to build smart inclusive environments, and a legal and governance framework regarding data concerns.
Good practices of responsive inclusive and eco-friendly environments can be found in the **Good Practices Blueprint**, providing an analysis of the respective exemplary practices and identifying key features for the success of Smart and Healthy Age-Friendly Environment (SHAFE) initiatives. Another component of the Social Innovation Framework, the **Capacity-building framework for social entrepreneurs,**

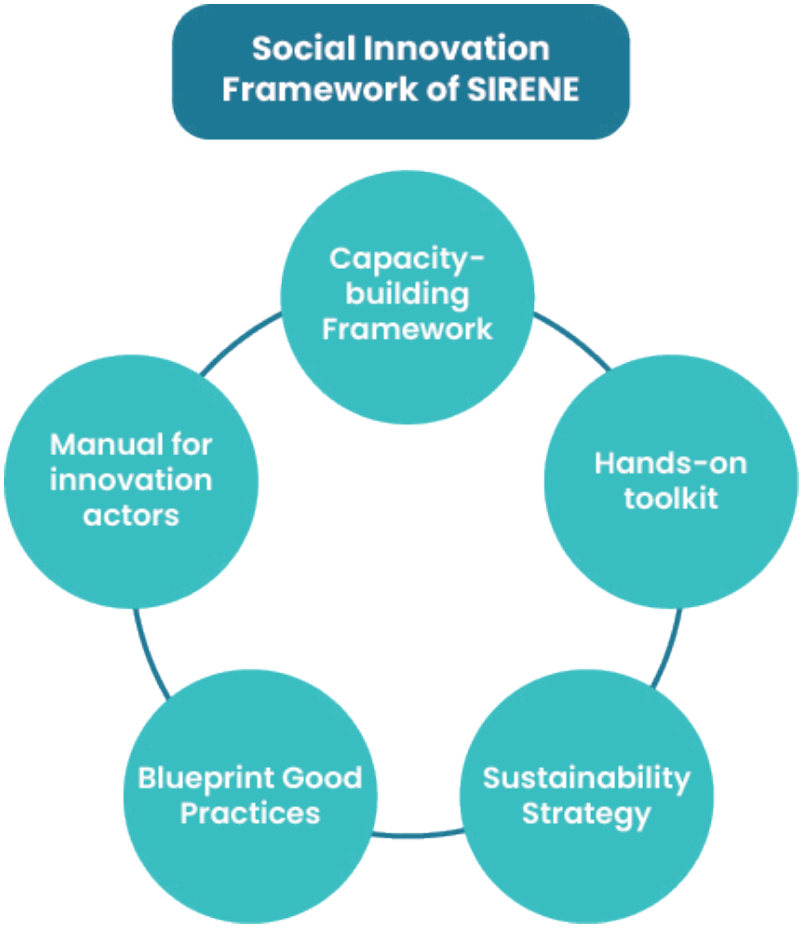


Figure 1: Social Innovation Framework

1.2. Structure of the manual

is especially focused on funding opportunities and securing investment. The **Hands-on Toolkit** provides information on networking and learning exchange initiatives. Last but not least, the development of a **Sustainability Strategy** will ensure the exploitation of the project results. Below you can find an overview of the different interconnecting components of the Social Innovation Framework of SIRENE:
All of you who work or are interested in responsive, eco-friendly smart housing and environments (SHAFE-inspired) can benefit from the information given in this manual. Particularly housing construction-related companies, developers of smart homes, technology providers and the general public can gain necessary knowledge for their work.

Innovation actors often need more knowledge of conceptualising innovation to know how it can benefit their work, its relevance and social impact and how to engage with local networks. This ensures the effectiveness and sustainability of the Social Innovation Framework, which demands continuous learning cultivation and an ongoing knowledge economy.

Innovation, especially social innovation, requires a certain openness to societal change and cultural shifts and can bring an additional value for your company and its impact on society. Did this spike your interest and do you want to get to know the more narrowed topic of social innovation? Have a look at chapter 2.2 “Social Innovation” below.

The manual for innovation actors starts with defining the concept of innovation and social innovation. Ecosystems are explored and the Transnational Local-sphere Model of SIRENE is introduced. Then the focus shifts particulary to responsive smart healthy age-friendly environments, the building of those environments and their impact in society. The manual concludes with an elaboration of legal and ethics considerations. As mentioned before, the **Good Practices Blueprint** covers the reference to good practices, which is why it will be linked with this manual and has a complementary function to its content.

The manual for innovation actors is the result of an extensive desk research. In addition, various experts have been consulted for the content of the manual and its development was made possible thanks to the collaborative work of the project partners.

2
INNOVATION ECOSYSTEMS

2.1. Innovation

Innovation is defined with two characteristics, the newness of an idea, product or service and its usefulness [1]. Innovation **impacts multiple fields**, such as cultural, technological, organisational, economic and social and its influence on (social) behaviour, cognition and societal development is immense [2]. Its societal impact underlines the importance to research innovation to gain from its potential value for entrepreneurs.

Innovation is a **driving force for human development** and it facilitates the adaptation processes to new environments. Due to the interdisciplinary aspect of the concept, it requires a **collaboration of agents** working in and contributing with their expertise to different fields. The **SIRENE project** is a good example of such a collaboration, since it involves ICT experts, policy and business experts, health and social scientists, urban transformation, housing, architecture and design experts. Such collaborations lead to the generation of diverse ideas, resources, and expertise, allowing businesses to explore their capacity of creative and innovative thinking. These collaborations can uncover novel solutions, stimulate (product) development, and open up new (market) opportunities.

Innovation itself is a neutral term and thus, the intention behind its use is crucial for its impact, which can be performed on an individual, meaning the learning of new, modified and more complex behaviour, as well as on a societal level. In this manual, we want to focus on the **societal level of innovation**.

2.2. Social Innovation

The manifestation of **social innovation** is defined as the **design and implementation of new solutions,** which aim to have a **social impact** on the future and improve the lives of individuals and communities by taking into consideration their health, researching relevant areas, combating societal challenges and ensuring accessibility of the offer [3]. Even though the concept is commonly associated with technological development, social innovation goes **beyond technological innovation,** being dynamic as such and in constant development. Moreover, for an innovation to be socially responsible, this responsibility needs to go beyond legal concerns [4]. As shown in Figure 2, social innovation is a very broad and complex topic, mainly aiming at finding novel solutions with a **user-centred approach** for social and environmental issues, and fostering change through novel ideas. Ultimately, those transformations will remain by developing and implementing **sustainable strategies** in the solutions. Hereby, the societal focus overweights the novel characteristics of the solution, thus, if a solution is successful on a social level but less on an innovative one, it is still a project that can be considered as socially innovative. For example, does the good practice mentioned in the **Good Practices Blueprint** 4.2.3 “Person-Centred Telecare” not rely particularly on new technology, but presents an innovative approach to the care system for older adults and can thus be seen as socially innovative.

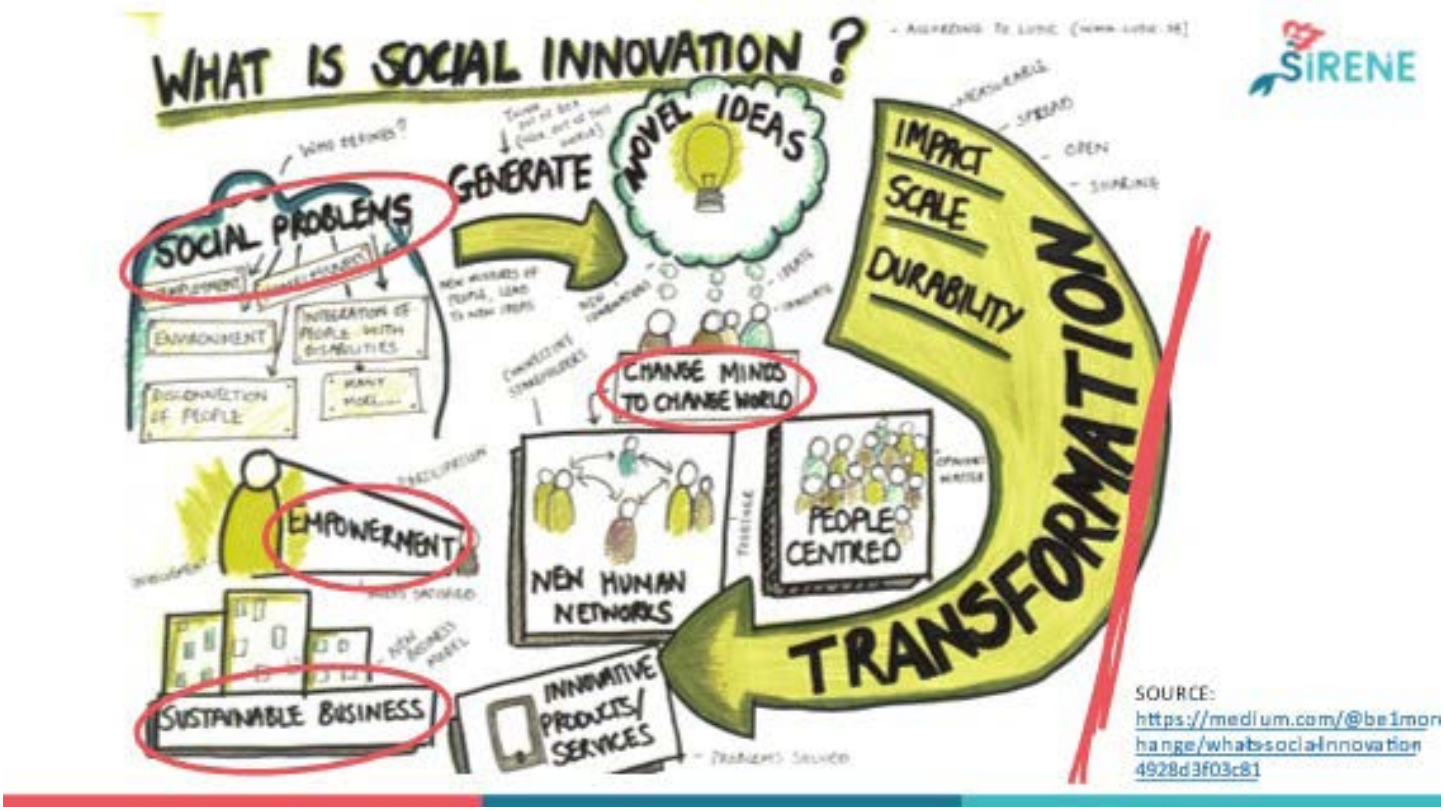


Figure 2: What is social innovation?

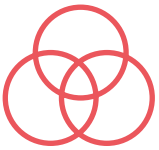
2.3. Ecosystems

An **ecosystem** is defined as a complex network with **interconnected components** working towards a **common goal** [1]. The term "components" refers to living beings, such as the innovation actors mentioned in the chapter below, as much as non-living artefacts, for example technology. By the interconnection and the **co-working** of these innovation actors in a competitive and at the same time collaborative environment, they **co-create a network**, which is the core of the ecosystem. The structures of an ecosystem can be agreed on verbally, for example in a community, or supported by policy regulations.

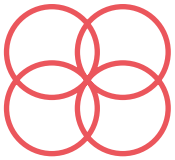
Within an ecosystem, the workflow moves in a **circular motion**, following the idea of a natural ecosystem, including components such as the natural balancing of resources, meaning that it exhibits resourceful energy and recycling of material. A **multi-sectoral perspective** is crucial to approach this broad topic, referring to actor-centred concepts, governance models, supportive infrastructures, and legal and cultural norms. These support systems within the community enforce the participation of its members and enhance the exchange of knowledge and experiences. It's essential that the ecosystem is built with a circled structure to help the community live a sustainable life, avoid resource waste, and ensure efficiency.

The Transnational Local-sphere Model

Within innovation economics several so-called 'helix models' exist, which are theoretical frameworks describing the possible interactions between actors, sectors, and institutions to foster economic and social development. The helix models can be used to define opportunities in innovation. Over the years, the models have been adapted to fit our current needs and demands better. For the SIRENE project, a new helix model has been proposed: the Transnational Local-sphere Model, which is focused on transnational cooperation and long-term sustainability. The model is based on the following frameworks:



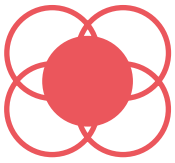
The **triple-helix** model was developed in 1995 to form an innovative environment that is encouraged, but not controlled, by the government. The model consists of three spheres, symbolising the government, academia, and industry. The overlapping regions represent hybrid organisations, like university spin-off firms and government laboratories [5].



In the **quadruple-helix** model, dating from 2009, a fourth helix was added: 'media-based and culture-based public'. The fourth helix covers concepts like 'culture', 'value', 'lifestyle', 'art', and 'creative industries'. It was created because culture and media greatly influence our society and political decision-making, and should therefore be incorporated into innovation systems and ideas [6].

The **quintuple-helix** model was introduced one year later, in 2010. In this model, the environment is regarded as a driver for knowledge and innovation and encompasses all other helices. The quintuple helix model stimulates investment in sustainable development. At the same time, the fourth helix is portrayed differently; encircling the triple-helix institutions on a different axis (in 3D), because it better symbolises the relationship between the helices [7].

In 2020 the **penta-helix** model was proposed, which extends the quadruple-helix model differently, by including a helix for 'social entrepreneurs/activists'. The model was made because the other models were considered to be too focused on institutions while neglecting networks of individuals and civic groups. The penta-helix model emphasises the role that people and organisations play in connecting the other four helices of the framework, enabling more diversity in stakeholders [8].

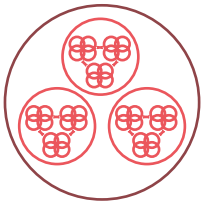


The **neo triple-helix** model was conceptualised in 2022 and integrates the triple, quadruple-, and quintuple-helix models. This model emphasises interactions, and is aimed to enable concepts like sustainable innovation, cross-sectoral interactions, transnational spanning, and indirect relations. The neo triple-helix model rethinks the theoretical grounds of the other helices and tries to clarify their interrelations while highlighting the transnational nature of innovation ecosystems [9].

The **Transnational Local-sphere Model** – proposed within the SIRENE project – **is a combination of the neo triple- and penta-helix frameworks**, incorporating interrelations between ecosystems, eco-friendly design and sustainability, as well as citizen focussed development and diversity of choice. This model puts more **focus on stakeholders, organisations, and underrepresented entities, is user-centred** by using a bottom-up approach, **includes (trans)national collaboration and competition (***co-opetition***)**, is *glocal* by **integrating global and local ecosystems**, and involves civic society, through the media and the public. By using the Transnational Local-sphere model existing local social innovation ecosystems can be connected and a network of stakeholders can be created in all sectors to ensure an accessible and sustainable result for its users.

Practical applications of the Transnational Local-sphere Model

The Transnational Local-sphere Model provides insights into the elements of the environments that should be considered, demonstrates the relations between actors and institutions of various regions, and supports the identification and roles of the stakeholders:



The outermost circle represents **the environment**. **Eco- friendliness** should be at the heart of all social innovation processes, including manufacturing, supply, and end solutions. Does your innovation use environmentally friendly construction methods and materials? Are resources provided by local suppliers? Is the end solution energy efficient? For more examples of how to make your solution eco-friendly, have a look at Chapter 3.3 and the action points in Chapter 2.4.

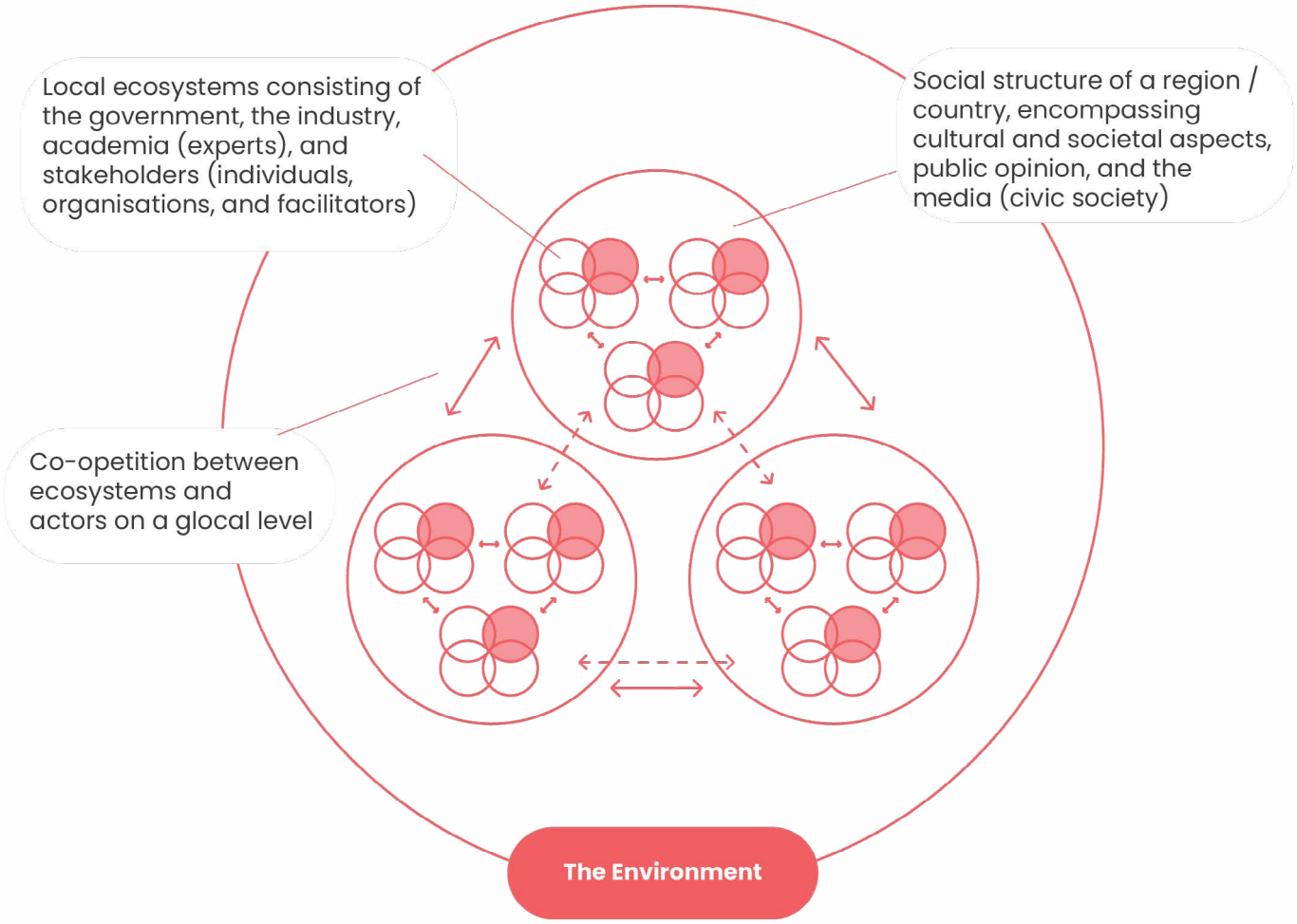
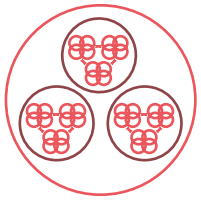
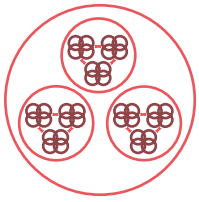


Figure 3: The Transnational Local-sphere Model



The middle-sized circles represent **local ecosystems** within the **cultural and societal structure** of a certain region or country. These local ecosystems are often bound by territory-specific laws and regulations, as well as the influence of the media and public opinion. Collaboration between these ecosystems is important for the sustainability, availability, and accessibility of social innovations. For this, a **balance of cooperation and competition** is needed between ecosystems and actors on both a global and local level. Is your social innovation replicable and scalable? Solutions should be made in such a way that they can be reproduced and adapted to different environments and operating systems, and adhere to different policy schemes and territory-specific standards and needs. ICT should be interoperable and capable of handling increased networking demands, innovations should be cost-effective, and financing schemes, quality management, and population density should be considered during development.



The smallest circles represent **the actors** within an ecosystem. **This includes the triple-helix actors**, i.e., local and regional government authorities, researchers, and the industry, but also various stakeholders, such as end-users, entrepreneurial cooperative networks of individuals and civic groups, and organisations, like health or service providers, the (social) housing sector, construction and installation businesses, real-estate agents, energy suppliers and ICT companies. By **including a wide range of stakeholders** (in a transnational setting), SI solutions will be both user-centred and expert-driven, as well as better implementable, more inclusive, and accessible to a wider range of people. Which stakeholders do you include in the development of your social innovation? Be sure to look critically at the business models of your chosen stakeholders and the priorities they have decided on, to ensure a value-driven solution instead of a market-driven one.

2.4. Actions to sustain innovation ecosystems

A functioning **innovation ecosystem** with a **socio-political focus** is needed to enable a flourishing environment for public, non-profit and private actors [10]. This way, innovation actors can co-construct and implement socially innovative solutions and contribute to addressing socio-economic issues, build stronger territorial resilience and increase adaptability to changes. The socio-political focus, meaning that financial support is offered and the participation of citizens fostered, must be implemented with a long-term perspective to enable fundamental and lasting change in society.

Providing education about relevant issues that society is facing and **offering guidance** by raising awareness and presenting potential solutions to those, are crucial for the implementation of social innovation programmes. Furthermore, this support is necessary to enhance social innovation, especially in the private sector where social innovation projects are often seen as non-lucrative. By facilitating the process of **application for financial support**, more innovation actors would be granted access to those supportive measurements and the distribution of funds between innovation actors would become more fair and equal. To **provide legal assistance** for the implementation of social innovation, the policy framework must consist of agents who will take action in the following aspects:

- Support funding of social innovative solutions.
- Create a set of supportive regulations that enhance social innovation.
- Conduct a participatory approach in the process of policy-making.
- Use public assets in a way established as socially innovative.
- Raise awareness and build skills of the public needed to navigate within the framework.

Besides the governmental aspect, the **economy** is recognised as a key aspect of social innovation. It is important to raise economic growth to increase the capacity and resources for the development of new products and technologies that serve society. The **business sector** can contribute to social innovation by providing skills and competencies, supporting sustainable business models and providing necessary resources, meaning associations, cooperatives and organisations carrying out social economy.

The emphasis on social engagement and innovation in the **academic sector** is crucial to enhancing an **open-minded culture** and approach to social innovation. The research aims to build knowledge on the topic, analysing (social) changes and identifying measurements and strategies for implementation. As mentioned in the previous paragraph, education on societal issues is essential to raise awareness and highlight the importance of addressing them directly.

This enhances a **discussion and communication culture** with inherent properties that foster social innovation, such as the sensibility towards certain topics, openness towards novelty, socially inclusive behaviour regarding including the affected individuals in the development and implementation of social innovation, as well as involving different stakeholders and thus, enhancing diversity. This **openness** in the cultural approach towards social innovation encourages an international view, which is necessary since social innovation needs to be **implemented on all levels**, including local, regional and national levels, as well as on an international scale. The amount of small-scale social innovation ecosystems operating on a local level has been growing over the years since many local challenges require innovative solutions. The project HASIC (Health Ageing Supported by Internet and Community), presented in the **Good Practices Blueprint** 4.5.2 “HASC”, has been conducted in 7 countries which enabels a repication and thus up-scaling of the project results in other environments.

2.5. Hands-on tools

It is important to be aware of the stage of development of the social innovation ecosystem in which your country and region are currently in. Below you can find a **few questions** to analyse the core aspects that must be considered for the **analysis of the local social innovation ecosystem**. These questions can be used as tools to explore and elaborate the social innovation ecosystem for your own projects.

1. Existing framework conditions:

The local context is essential to know the resources available to implement, maintain or enhance a social innovation ecosystem. The following questions will help in the later design of the implementation, such as policy measures:

What are the needs of the local system? What are the existing laws and regulations? Does it have an active civil society? Are the framework conditions beneficial to the ecosystem?

Another important aspect here is the thought of co-creation, meaning that it is important to gain information about the current overall situation around social innovation, and thus know about potential cooperating cities.

Who are potential stakeholders? Which neighbouring cities might be interested in cooperating? What are their resources and capacities?

As mentioned above, analysing the local context includes gaining an overview of the cultural situation. Knowing about cultural attitudes and identifying types of behaviour can help identify the need for social innovation within the community.

What is the level of life satisfaction? What are the social attitudes? What is the level of education and unemployment? Are people concerned with the environment locally?

2. Policy implementation measures

Another core aspect is policy implementation measures, which include organisational structures in policy-making at a local level, them being laws and regulations to enhance social innovation. Be aware that social innovation can require a change in existing legal regulations, which is why it is important to know the current state of the market and if there is a demand for social innovation initiatives and in which area.

Is social innovation referenced in one or several relevant policy documents? Is there a leading institution for social innovation policy development? Is there a coordination mechanism in place to share information about social innovation implementation? Are local social innovation actors involved?

3. The progress dynamics monitoring

A circuit implementation process means that the changes are constantly monitored and considered in a returning feedback loop to enable analysis of the efficiency of the measures and adjust the framework if required.

Are the measures effective? Can you identify a new target group? Is there a new demand for social innovation programmes? Can you see a significant and positive change in the community?

2.6. Innovation actors

With the help of **innovation actors**, society drives towards a **shift in the minds** of the individual and the collective by improving their ability to encounter future challenges independently, enabling them to lead a self-determined life and empowering citizens to social and political participation for a greater societal change. Being an innovation actor also involves inspiring others to a more open and flexible thinking and to gain a holistic perspective on the innovative measures that are being taken.
Innovation actors are those who invest their time and/or money to contribute to societal change by thinking of innovative ideas and solutions and taking the initiative to realise them. Within the **multifaceted profile** of innovation actors, they often show these characteristics [11]:

- Responsible
- Independent
- Open for novel approaches and concepts
- Creative and flexible in their thinking
- Problem-solving oriented
- Showing management skills and motivation to pursue their goal

In the following, you can find a few out of many examples of innovation actors:

- **Housing cooperatives** are initiatives were the members rent properties for collective living with joint responsibility. They offer to independently manage the residential complex and share spaces and facilities with each other. Among other benefits, these initiatives can provide access to suitable housing by providing lower-cost housing and sharing the costs between its members.

- **Research institutions** provide research and often have educational value for the public. They are considered innovation actors because of their critical role in the development by creating and diffusing knowledge and teaching valuable skills through experts. They can offer measurements, frameworks and guidelines to legal and governmental actors. The research project mentioned in the **Good Practices Blueprint** 4.1.2 “Place-Making with Older Adults: Towards Age-Friendly Cities and Communities” shows the importance of bridging gaps in research with a multilevel, cross-cultural and participatory approach and its effect on the quality of life of the target group.

- **Governments** who promote innovation and support the creation of innovative environments to foster novel ideas are innovation actors as well. Research can flourish with their financial support. They often facilitate local and regional networks and ecosystems and act as partners and collaborators.

- **Startups and enterprises** are highly innovative as they can more easily adapt to market changes and implement technology in their approach. Innovation can be explored by startups and enterprises and their encouragement of the novel brings growth to these companies.

2.6.1. Profile of innovation actors

The profile of an innovation actor is inclusive and the role can be acquired **by anyone who takes on social responsibility.** Compared to other entrepreneurs who act with a focus on profit, a **social innovation actor works upon the needs of society** and finds an inclusive solution-seeking approach, independent from the financial return of those implementations [12]. Examples can be the development of the infrastructure in rural areas, empowering non-profit organisations or facilitating the entry into the labour market for refugees, since these actions are driven by the awareness of the societal benefits of such measures.

In the table below you can find the **differences between innovation actors** and social innovation actors at one glance:

Domain	Innovation actor	Social innovation actor
General aim	Focus on the creation of new products and services.	Focus on finding solutions to societal and environmental challenges.
Tasks	Promotion of innovation, knowledge creation, and diffusion. Transforming their business through innovation in various areas.	Promotion of social innovation, raising awareness on societal and environmental challenges, and implementing a human-centred design considering social inclusion and participation throughout the process of implementation.
Financial focus	Innovation actors are often business-oriented and therefore driven by economic growth.	Social innovation actors are not necessarily driven by economic growth, their core focus lies in creating social value.

Table 1: Differences between innovation actors and social innovation actors

3
RESPONSIVE, ECO-FRIENDLY ENVIRONMENTS

In this chapter, we will further explain the concept of responsive eco-friendly and smart healthy age-friendly (SHAFE) environments and how they can be realised.

3.1. What is SHAFE?

S – Smart
H – Health
A – Age
F – Friendly
E – Environments

Figure 4: Smart Healthy Age-Friendly Environments overview

The core aspects of SHAFE

The focus of SHAFE

Lies on creating smart, healthy and age-friendly environments, giving importance to citizens' participation in society and co-creation of innovative actions. These are the same components of creating responsive environments, which is why they can also be called SHAFE. SHAFE environments are inclusive and accessible and imply the need for a combined infrastructure. Therefore, it combines health with ICT, social and built environments, including a user-centred approach. SHAFE aims to promote and implement healthy and active living, equal access to services and active participation in society through the use of digital innovations and services. Other topics covered are granting access to relevant networks and funding opportunities and enabling innovation investments. If you want to read about a good practice of an innovative grant programme, have a look to the **Good Practices Blueprint** 4.1.3 "Age-Friendly Home Adaption/ Equity Residential Rehabilitation Grant Permit Program".

The SHAFE initiative

Started as a European Thematic and stakeholders network and became an official network of European Cooperation of Science and Technology (COST) in 2020. The COST Action NET4Age-Friendly consisted in 2023 of over 700 contacts from 51 countries and will deliver in 2024 the Reference Framework on SHAFE [13]. The Reference Framework will entail, among others, good practices, guidelines, standards, co-creation methodologies and capacity-building approaches. From 2024 the network will proceed in the **International Foundation on SHAFE**, which conducts research, creates an international network of stakeholders and provides training and activities related to SHAFE [14].

3.2. Building smart inclusive environments

It is crucial for technology which is embedded in human's everyday lives and constantly provides services, information and communication to be responsive, meaning to **react quickly to changing circumstances and needs** [15]. What does that mean for the **building of smart inclusive environments in smart housing**? It means to prioritise the user's comfort, safety and well-being over other considerations. On the other hand, society needs to be responsive to technological changes, such as dealing with raising data concerns mentioned in 23. The term responsiveness applies to **social adaptability** to a new environment or situation as much as a technologically responsive environment, such as the housing sector, where artefacts show real-time sensing, climate-adaptive and self-learning elements. Hereto, a responsive, inclusive, eco-friendly living environment must contain technology and physical design **facilitating comfort, access and mobility**, but apart from that also include an offer for greater **engagement, inclusion and privacy**. The design must be **user-centred** and provide easy access and navigation in and around to meet the changing needs of occupants over their lifetimes. Essential characteristics of such environments are the capability of **cost-effective adaption**, to ensure being **environmentally friendly** regarding used materials, energy and water consumption, and the use of local suppliers.

As mentioned, a responsive, inclusive, eco-friendly living environment must contain technology and physical design **facilitating comfort, access and mobility,** but apart from that it also must include an offer of greater engagement, inclusion and privacy. The following question arises: **how to build these smart inclusive environments?**

A big part of this question will be answered by the framework conditions that will facilitate the promotion of these smart, inclusive environments. As stated in the research within the Homes4Life project [16], some **factors influence the development** of these environments, and they have the potential to both encourage or turn out to be a barrier for those who want to implement SHAFE initiatives. Below, some of these influencing aspects are mentioned:

- **Regulatory framework:** the existence of legal provisions for accessibility, home adaptation, and home care services are clear facilitators for SHAFE initiatives. On the other hand, when there is not a clear regulatory framework, it is more difficult to promote them.

- **Existing know-how:** having official guidance (e.g., Handbooks and accessibility standards) and supportive organisations is a key enabler.

- **Financial incentives:** grants and tax credits/ reductions for retrofitting and new smart inclusive constructions can help those stakeholders who want to build smart inclusive environments.

- **Housing governance:** the existence of specific institutions can support in the design to identify, plan and deliver living environments that cover the future demands of the population.

Meeting all these factors would mean that the **administrative and economic context** are favourable and that public administrations are fully convinced of the importance of building smart inclusive environments. From the practical point of view, this commitment could be translated into the inclusion of this SHAFE approach in public housing procurements. To cover the social context, we would also need a **cultural shift and new learning**.

The project Hands-on-SHAFE explores these topics by **providing knowledge on creating a SHAFE environment** by considering the following **4 areas** [17]:

SMART

Building a smart environment by including technology in the social innovation process and by using ICT for independent living, housing and social innovation is essential to create a SHAFE environment. The definition of a responsive environment and the corresponding aspects that need to be considered are given above.

HEALTHY

It is necessary that every citizen knows how to access the healthcare system, which is continuously becoming digitalised. The promotion of healthcare, healthy indoor and outdoor environments, and raising awareness of physical, mental and social well-being is therefore crucial and will bring both societal and individual benefits.

BUILT

This aspect focuses on housing and mobility, which largely influences the aspect of health. The safer, more comfortable, smarter and easier-to-maintain the environment is, the more people will be able to remain healthy, in the sense of social and health care. It is the responsibility of facilitators, counsellors, and end users to remove physical barriers and create smart healthy age-friendly physical environments in their own homes or neighbourhoods. By building such environments the use of an universal and inclusive design towards accessibility must be considered.

BUSINESS

It is important to support entrepreneurs to successfully implement the products and services in the different SHAFE areas. The best way to do so is to provide them with the necessary tools for their projects.

Society and public administrations might recognise the need to develop smart inclusive environments and from the economic point of view it might be proven as a sustainable solution, but in the process of designing, building and implementing these environments, **some further skills are required**. These skills concern the technological solutions that would make our environments inclusive and smart but are not offered in many markets since this approach is unusual at architecture and engineering schools. Thus, including the SHAFE approach in both university and vocational **education and training programmes** is compulsory if we want to achieve these smart inclusive environments.

To conclude, to build a smart responsive, inclusive and eco-friendly environment we need:

- A favourable context both from the administrative and the economic point of view.
- A cultural shift in society and a new way of learning.
- A stakeholder ecosystem with the required capacities and skills to design and implement smart and inclusive environments.

A smart responsive, inclusive and eco-friendly environment should:

- Embed technologies that compensate for any deficits in users' capabilities.
- Use technologies to improve the lack of accessibility that can be found in current architectural/building designs.
- Be designed or redesigned with adaptable and reusable frameworks for a continuous adaptation of services to users.
- Have a level of intelligence that enables services to be improved.
- Make devices, data, information and management systems available to the consumer, with an interoperable and user-friendly interface that allows the user to control privacy settings and services according to data protection guidelines (e.g., General Data Protection Regulation in Europe).
- Provide efficiency in terms of safety, security, independent living and energy and water savings, taking into consideration climate change and being resistant to extreme weather conditions.
- Encourage and facilitate social participation of the occupant in the neighbourhood and other social contexts.

3.3. Sustainability

Sustainability plays a key role in the concept of innovation. You, as innovation actors, are in charge of implementing sustainable aspects in the process of innovation by creating a sustainable framework. This framework is needed to enable the implementation of innovative solutions.

The priority of social sustainability is humans and their well-being, making sure to **create a safe environment for them and meeting their social needs**. Consequently, this also means taking into consideration **climate change** and implementing a **circular motion** in different areas, such as environmental, but also economic developments.

The fundamental concept of sustainability revolves around the capacity to uphold or facilitate a process over an extended period. It is frequently divided into three key dimensions: social, economic, and environmental.

SOCIAL

Social sustainability centres around the welfare of **individuals and communities**. By definition, smart, inclusive environments inherently embody social sustainability. They help to overcome socioeconomic inequality, discrimination, prejudice and social exclusion, lack of access to resources, insecurity, and conflict.

The goals to be achieved by social sustainability are:

- Advocating for policies that uphold fundamental human rights, such as the right to health and education.
- Embracing inclusive practices that recognise and incorporate individuals from diverse backgrounds, including differences in gender, ethnicity, ability, and sexual orientation.
- Establishing safer living environments and enhancing the efficient delivery of justice.
- Enhancing the overall health, mental well-being, and physical fitness of individuals through the provision of high-quality healthcare services.

By promoting and fostering smart inclusive

environments, many of these goals are achieved, establishing safe living environments, that enhance health and mental well-being, recognising and incorporating individuals from diverse profiles and facilitating access to fundamental human rights.

INFOBOX Concrete action points for Social Sustainability

- Educate about key societal topics.
- Promote healthy living.
- Raise attention to mental-health issues and provide support.
- Organise intercultural activities.
- Ensure and enable accessibility of healthcare services.

ECONOMIC

Economic sustainability involves conducting economic activities in a manner that **preserves and fosters long-term economic prosperity**. In practice, it strives to establish an equilibrium between economic growth, resource efficiency, social equity, and financial stability. Achieving these goals requires fostering social and economic inclusion, technological innovation through dedicated investments, promotion of efficient and transparent governance, as well as public awareness and education.

Requirements for making smart inclusive environments economically sustainable:

- Taking constructive and technological measures and solutions to minimize the environmental impact.
- Guaranteeing access for everyone to these smart inclusive environments, ensuring social and economic equity.
- Basing them on economic systems that have the ability to withstand and recover from various disruptions, shocks, or challenges, and to increase adaptability to new situations.
- Involving companies with a more widespread adherence to management based on principles of responsibility and ethics.

INFOBOX Concrete action points for Economic Sustainability

- Take a multi-stakeholder approach.
- Make your solutions replicable and scalable.
- Make technologies and services affordable and interoperable.
- Implement a circular economy.

ENVIRONMENTAL

Environmental sustainability is shaped by various factors that wield substantial influence over the ecological equilibrium and the Earth's capacity to support life. Among the **primary contributors** are:

- Pollution of air, water, and soil.
- Climate change is driven by the excessive emission of greenhouse gases resulting from human activities.
- The decline in biodiversity.
- The excessive utilization of natural resources.
- Economic models are characterized by unsustainable consumption practices

INFOBOX Concrete action points for Environmental Sustainability

- Use inclusive design methodologies.
- Choose energy efficient methods for production and use.
- Use resources that are renewable or recyclable.
- Make adequate use of greenery.

3.4. Return on investment and impacts smart inclusive environments

The building of smart inclusive environments is a property investment that is currently threatened by circumstances such as soaring energy prices, higher wages, and higher costs for materials. At the same time, new builds must demonstrate their worth of being socially, economically, and environmentally viable. This value can be assessed by using the social, economic and environmental impact assessment approach of SHAFE SEE-IT [18].

The SIRENE project envisages to perform the **social, economic and environmental impact analysis** with a **diverse group of stakeholders**. They jointly define the core challenges and the aims and objectives needed to enhance innovation. First, a baseline scenario is decided on and then solutions for the issue presented are provided. After the ground has been set, the joint **assessment and analysis** starts. The group of stakeholders defines which domains of impact are appropriate to be assessed, the direction of the impacts (neutral, positive or negative), and the intensity of the impacts (neutral, strong or very strong). Additionally, the impacts are quantified, for example by defining the scale (the number of people, organisations, and communities affected), the significance (the value or importance), costs, gains and losses, or adjusted healthy life years.

34 the domains of impact and possible impacts for consideration are presented. The general return on investment of smart inclusive built environments contains the following aspects:

SOCIAL IMPACTS

- Improving health and longevity by improving the quality of life and supporting a healthy lifestyle.
- Supporting physical, social, and data safety by ICT systems and alarms.
- Ensuring social inclusion and supporting informal care by enabling social participation and monitoring.

ECONOMIC IMPACTS

- Improving the basic standards of living by providing appropriate accessible housing.
- Public budgets for community support, health and social care, transport and public services can be disclosed for individual purposes.
- Improving market opportunities for the housing and ICT sectors by enlarging the stock of appropriate housing and ICT solutions.
- Enhancing research and innovation by enabling pilots and new applications.

ENVIRONMENTAL IMPACTS

- Improving the quality of the local environment by providing inclusive housing facilities.
- Positively impacting energy-saving opportunities by the usage of sustainable materials and monitoring opportunities.
- Largely improving quality of housing: accessible, appropriate, inclusive, embedded smart solutions.

4
LEGAL AND ETHICS CONSIDERATIONS

While building a Social Innovation framework, ethical concerns need to be taken into consideration to acknowledge legal, ethical, and gender aspects.

There are three types of ethical concerns:

- **Data concerns:** use of personal data
- **Societal concerns:** potential discriminatory effects of appliances or policies
- **Implementation concerns:** implementation of smart solutions on a large scale
- All three of the above mentioned ethical concerns will be elaborated on in this chapter.

4.1. Data concerns

Privacy is a fundamental human right recognised in the UN Declaration of Human Rights, the International Covenant on Civil and Political Rights, and in many other international and regional treaties. It is related to human dignity, freedom of association, and freedom of speech. **The right to privacy** is connected to the need to protect data. For this reason, this subchapter will describe important topics related to data protection, particularly concerning the General Data Protection Regulation.

The **General Data Protection Regulation** (GDPR) is a comprehensive data privacy and protection regulation, implemented by the European Union (EU) in May 2018 [19].

What the GDPR does:

- It provides a single set of rules for data protection that apply uniformly across all EU member states, simplifying compliance for businesses operating within the EU.
- The GDPR gives individuals greater control over their personal information by allowing them to access, correct, delete, or export their data.
- It also introduces the "right to be forgotten", which allows individuals to request the removal of their data under certain circumstances.
- The GDPR additionally imposed stricter rules on organizations that process personal data. After the regulation implementation, they are required to implement appropriate security measures, obtain explicit consent when collecting data, appoint data protection officers (DPOs) in certain cases, and report data breaches promptly. According to the GDPR, personal data includes data about the identity of an individual, and sensitive information about this person, including cultural background, political opinions, religious beliefs, health condition, sexual preferences, or potential criminal records.

The GDPR sets out seven key principles that lie at the heart of SIRENE's approach to the processing of personal data.

GDPR Key Principles

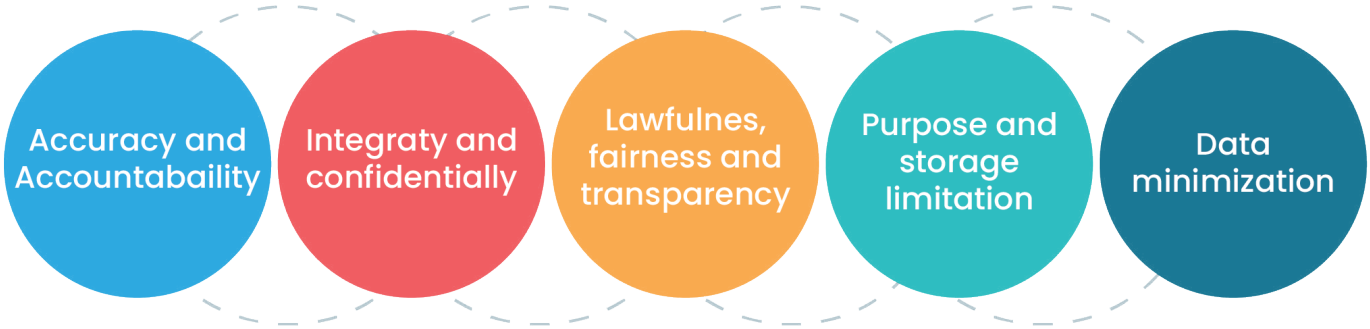


Figure 5: GDPR Key Principles

Additionally, it's crucial to consider the privacy rights of the data subjects.

Privacy rights of the data subjects

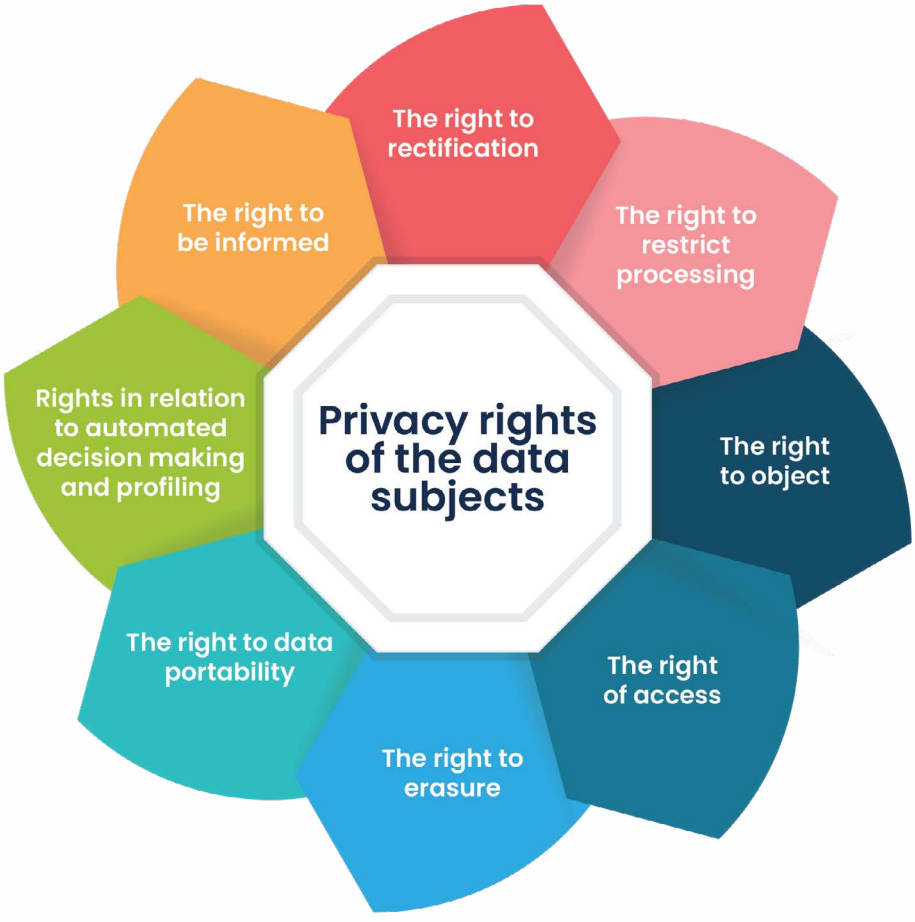


Figure 6: Privacy rights of the data subjects

What to consider while processing personal data?

Processing data should be conducted in a lawful, fair, and transparent way.

Personal data should not be further processed, archived, or published other than for specified, explicit and legitimate purposes.

Only adequate, relevant, and limited data that is necessary for the purpose is to be collected.

Personal data should be accurate and up to date.

Data is not to be stored for longer than necessary for the purposes.

Appropriate security of the personal data must be ensured, including for example the protection against unauthorised processing or accidental loss.

The controller is responsible for the personal data.

Personal data should only be transferred to a third party that is aligned with the purpose.

When integrating Internet of Things (IoT) technologies in smart buildings more (specific) aspects need to be taken into account while processing personal data. Smart buildings are structures that use technology to enhance resource efficiency and improve the comfort of the residents [20].

Data Minimisation and Purpose Limitation [21]: When integrating IoT technologies, it is vital to **avoid the collection of excessive or irrelevant data**. It is necessary to gather and process only the personal data that is necessary for the intended purpose. Moreover, a clear and comprehensive explanation must accompany the collection and processing of personal data, ensuring that such data is not repurposed for other uses than those for which it was originally collected [22].

Data Security and Retention: Robust security measures must be put in place to **safeguard personal data** from unauthorized access. Providing users with control over who can access their data and how it can be utilized is paramount. Additionally, it is essential to establish data retention policies to ensure that IoT devices do not indefinitely retain personal data. The personal data should be deleted when it is no longer required for its specified purposes.

User Access and Control: Granting individuals the ability to access, review, correct, or delete their personal data as needed is crucial. Users must also have tools at their disposal to ensure the accurate collection and purpose-specific use of their data. Implementing a comprehensive data history that tracks the data source, modifications, and access is essential for maintaining control over data usage.

Privacy by Design: Privacy considerations should be **integrated into the design** and development of IoT devices and systems from the outset. Users should have control over who can access their data, necessitating fine-grained access control on a per-user basis. To isolate data within the system and maintain confidentiality, the provision of tools to achieve this level of control is indispensable. This ensures that other users are unaware of the data's existence or its specific details [23].

User Education: **Users should be educated** about the data collected, how it is used, and their rights regarding their personal data [24].

Using data is inevitable for smart healthy environments and solutions but it raises additional questions about the **ethical handling of this data**. Smart city technologies often involve extensive data collection from sensors, cameras, and other sources. This raises concerns regarding the surveillance of citizens' daily activities and the potential for unauthorized access to sensitive personal information. For that reason, ensuring the security of the data collected is a challenge that must be dealt with.

It is important to ensure that:

- Transparency and public engagement are being considered.
- Privacy by design is implemented.
- Data ownership rights are clarified, and data-sharing agreements are established.
- Equity and inclusion are prioritized.
- Data security is maintained.

How to use personal data ethically?

Addressing ethical issues requires careful planning, transparency, public engagement, and robust data governance frameworks to ensure that IoT technologies in smart buildings and smart city solutions enhance the quality of life for all users while respecting their rights and values.

The main measure is to anonymise personal data by for example using **pseudonyms** to re-identify personal data. This way personal privacy can be maintained.

4.2. Societal concerns

Technocratic policymaking

One current societal concern is that all aspects necessary to build healthier and inclusive living solutions are being solely measured and treated as technical challenges that require technical solutions. This approach is called technocratic policymaking, which can usually be identified by the following aspects that are included in most of the policies around this topic:

- Prioritising economic value generated through public-private partnerships.
- Using algorithms to find stakeholders.
- Not questioning the business models of strategically chosen stakeholders and their general approach.
- Not being citizen-focused but claiming to be so.
- Using Artificial Intelligence.

How to counter the societal concern of technocratic policy-making?

It is important to incorporate a **multi-stakeholder** approach by including civic groups, like social entrepreneurs, intermediaries, and activists. By doing so, socio-political awareness and democracy are promoted and involved stakeholders can easily point out the missing policy areas that are missing attention. The project presented in the **Good Practices Blueprint** 4.6.1 "Ennis Age Friendly Town" provides a collaborative decision-making process by involving citizens, as well as multiple local stakeholders.

Data-driven urbanism

Data-driven urbanism is based on a large amount of r**eal-time data**, which is constantly being collected through private systems, such as transport services, home appliances, and social media. Including big data as such into policy choices has a positive aspect but it needs to be carefully considered to avoid contributing to a technocratic governance, which brings the risks mentioned in the previous chapter.

The major benefits and disadvantages of this data-driven approach are as follows:

Benefits	Disadvantages
City systems can become **interconnected.**	**Datafication**: Human actions are objectified and reduced to numbers.
They can improve the **efficiency and effectiveness** of the systems, providing citizens with highly responsive city environment.	Real-time data cannot fully represent human needs & the **complexity of an urban environment.**

Table 2: Benefits and disadvantages of data-driven approach

A multi-level approach, meaning an integration of different big data sources with other forms of consultation and data collection is needed as a means for citizens to gain increased control over which data is shared with whom, and for what purpose.
Also, standardised guidelines and protocols are needed for smart environments and products to keep regulations up to date to avoid technological failure.

What should be considered?

- Conforming services: Conformity is needed when integrating utility systems, such as energy systems, water supply, and emergency response. It is needed to enable real-time exchange between service providers to prevent distribution loss.

- Scalability: The ICT infrastructure needs to be able to handle the growing network demands. Regulations are required to arrange equal access to smart systems to avoid a shortage of the systems.

- Application procurement and organisational collaboration: The procurement processes need to be kept up to date so that projects are not delayed due to legislation. Ethical conduct can ensure collaboration between organisations during the implementation of a new project.

- Data ownership: It must be clear who owns the data that is collected and with whom it may be shared.

4.3. Implementation concerns

Coordination aspects: Service providers, institutions and local relevant stakeholders, both public and private, should be able to coordinate and integrate their actions to build a living environment that is inclusive and responsive. Benefits are:

- Enabling the identification and tackling of the needs of individuals more comprehensively, and consequently developing solutions capable of responding effectively and efficiently to them.

- Addressing necessities through a multi-level and integrated approach allows to avoid conflicts, overlapping, and consequent waste of material, human and financial resources.

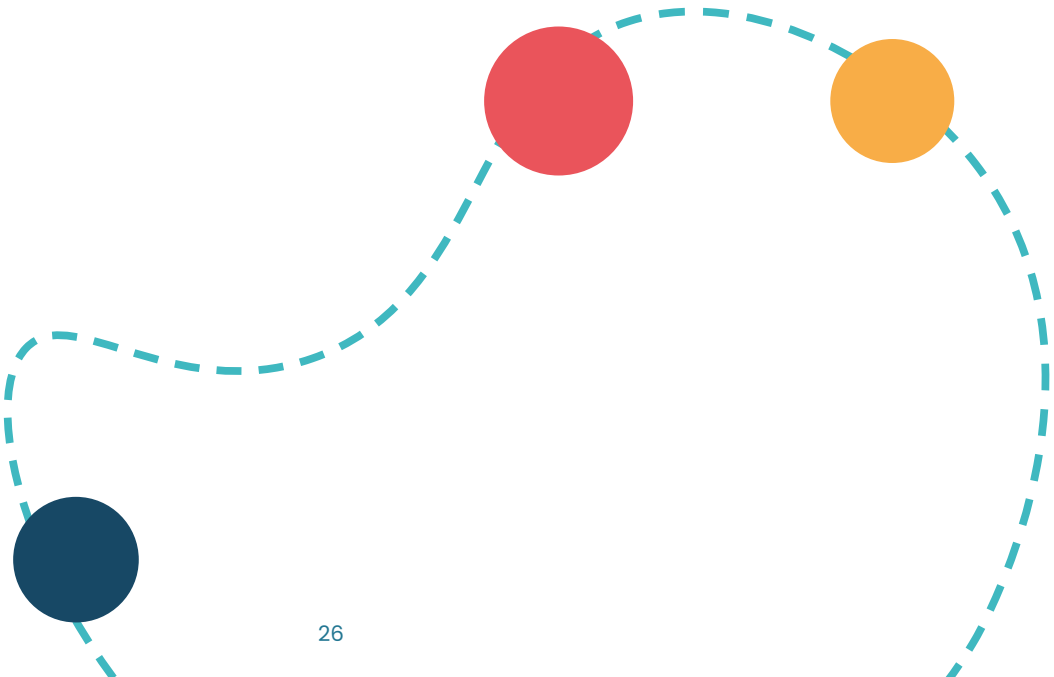
For this to happen, there should be a shared up-front vision of the desirability and necessity of developing SHAFE environments where the benefits and gains to the individual organisation in investing in it are evident.

Political issue for approval: As highlighted, the construction of smart living environments requires good coordination of multiple actors, both public and private. To this end, the development of policies that incentivise investment and partnerships should be encouraged, so that processes are facilitated and a benefit for all parties is involved. It is important that **policy- and decision-makers are taken on board from the initial stages of the project** and that they share the conviction that investing in the construction of SHAFE not only has a positive impact on what concerns housing policies but also has a strong significance for social

and health implications. Institutional approval and construction can sometimes be a lengthy and winding process that could be lethal for the implementation of certain real estate developments, particularly if the economic viability and sustainability of the intervention are too fragile to accommodate features of equality, accessibility and other social factors. For this reason, it is paramount that these building developments achieve unfaltering **political support** throughout the implementation process of the scheme. A good example of support from the political sector in SHAFE can be found in the **Good Practices Blueprint** 4.1.1 "Housing Options for Our Ageing Populaiton" , concerning the implementation of a policy statement in Ireland that supports older people in finding housing for independent living.

Health and wellbeing provision: From a general perspective, when it comes to health and wellbeing, smart homes should **support autonomy, individual agency, self-determination,** and the possibility to easily ask for support in case of emergency. They should be equipped with sensors, basic home automation solutions and automation solutions based on residents' specific needs to facilitate and support daily activities and self-care. Moreover, they should foresee sensors to guarantee remote monitoring. **IoT solutions** should also be envisaged with the same objectives. The possibility of using wearables for self-monitoring that can interact with the ICT of the living environment should also be considered. Furthermore, remote care solutions should be integrated into the living environment to facilitate interaction and dialogue between residents and the health and social services and health professionals. With particular regard to home care, it would be appropriate if smart housing solutions are easily reached by service providers, so as to encourage the punctual and reliable availability of this service. Finally, it is desirable for such housing solutions to be organised to facilitate the **creation of community care and support networks,** another important element which can have a positive impact on health and wellbeing.

Artificial Intelligence: Artificial intelligence is becoming more and more important in the creation of responsive environments and brings with it the **need for ethical measurements** to ensure that the personal data and identity of citizens are protected. A machine is incapable of coping with this issue and thus, the measurements need to be programmed to ensure their ethical excellence when incorporating AI into responsive environments.



GET MORE INFORMATION

REPOSITORY

In **SIRENE's Repository** you can find a collection of the results of the social innovation framework, the co-creation network and the sustainable strategy developed within the SIRENE project.

What information will you find there?

The topics covered in the repository are **SHAFE-oriented**, such as information on social innovation, community, health and social care, housing, policy and funding, urban transformation, ICT for independent living and information technology.

Additionally, by clicking the Information Icon, you will be directed to an **interactive statistic**, where you can select and change the given output by clicking on the statistics.

What features does the repository have?

You can **access** the repository and consult more information through this link: LINK .
If you want to **contribute** to the repository you can fill out this form and enter the necessary information: LINK. The content you suggest will be openly available online after approval from the SIRENE consortium.

NET4Age-Friendly

NET4Age-Friendly works on creating **social innovation ecosystems** by putting the focus on the health and well-being of the society members and implementing an **age-friendly digital environment**. The network includes an international range of interdisciplinary researchers, bringing them together to establish local and regional ecosystems. Find out more on the NET4Age-Friendly **website**.

Hands-on SHAFE

In the chapters above we have elaborated the SHAFE Framework and mentioned the **Hands-on SHAFE** project. Did this spark your interest and do you want to learn more about the learning experience and hands-on tools needed to implement a SHAFE environment? Find out more information about the learning platform **here**.

Homes4Life

Homes4Life aims towards healthy living environments and age-friendly housing by providing a **certification scheme** that has already been tested by various countries in Europe. Find out more information in **this brochure**.

Do you want to contribute with your ideas? Homes4Life also offer an online form, where you can contribute. You can find the link to the **online Feedback** form on the Homes4Life taxonomy and KPI framework **here**.

GoodBrother

GoodBrother is a **COST action network** on applications for active and assisted living (ALL) which have a high consideration of **data privacy**. As mentioned in the chapter above, new technological developments and their implementation in innovative and technological solutions for a more independent and active living environment have raised data concerns. Thus, it is of high importance to provide research on the topic to inform and educate the public and provide safe ICT solutions for the user.
Here you can find the link to the Goodbrother **website**.

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Annex I The different domains of impact

Social impacts

Table 3: Domains of social impact

Domains of impact	Possible impacts for consideration
Health & longevity	Does the social innovation support a healthy lifestyle and/or increase life expectancy? Consider the following potential impacts: • Increasing physical activities • Improving mobility • Preventing falls • Improving mental wellbeing • Preventing chronic diseases
Safety	Have all safety aspects of the SI solution been taken into account? This includes: • Safety indoors • Safety outdoors • Data security in digital devices and services
Meaning & inclusivity	Is the initiative meaningful and inclusive? Were the following topics considered: • Employment and voluntary work • Enabling / improving informal care • Respect for different perspectives and lifestyles • Social inclusion • Opportunities for leisure
Education & lifelong learning	Does the innovation pertain to education (levels) in any way? Is it equally accessible for all people? Think of: • Literacy (health, digital, data) skills • Access to higher education • Educational attainment • Opportunities for lifelong learning
Quality of social interactions	Have social interactions been taken into account? How does the innovation relate to: • Social networks and friends • Loneliness and isolation • Social and religious participation • The impact of migration, ethnicity and/or language on the individual and on society
Private & family life	Have impacts been considered on all levels of life? • Impacts on individuals • Impacts on households • Impacts on families
Personal data	Does the innovation make use of data? Consider the following topics: • Access to information • Safe-guarding identity and regulating identifiers • Protection of data and the sharing of information
Basic rights & responsibilities	Have all basic rights been taken into account? Such as: • Human dignity • Equality • Freedoms • Justice • Solidarity • Citizens' rights (EU Charter of Fundamental Rights)

Economic impacts

Domains of impact	Possible impacts for consideration
Standards of living	Does the innovation solution account for the basic standards of living? • Financial means should be sufficient to cover the basic needs of living • Appropriate housing should be available and accessible
Economic prosperity	Does the solution pertain to economic prosperity in the following fields? • Gross national / regional income • Number of employed / unemployed people • Household savings
Public budgets	Are there public budgets involved? Such as those for: • Community support • Health and social care • Information and communication • Education • Transport • Public services
Market mechanisms	How does the innovation impact the market? What are the effects on: • Private sector business opportunities / SMEs • Private social enterprise opportunities • Transactions between sectors
Innovation & R&D	What are the expected outcomes in research and development? Are these topics involved: • Investment in R&D • Intellectual property • Accelerated time to market
Sustainable consumption & production	Does the solution fit current sustainability standards in the following areas? • Household structure and expenditure • Household energy use • Car ownership • Persons at work in private sectors
Property rights	Are the relevant rules and regulations for property use considered? Does the solution deal with: • Homeownership • Social housing

Table 4: Domains of economic impact

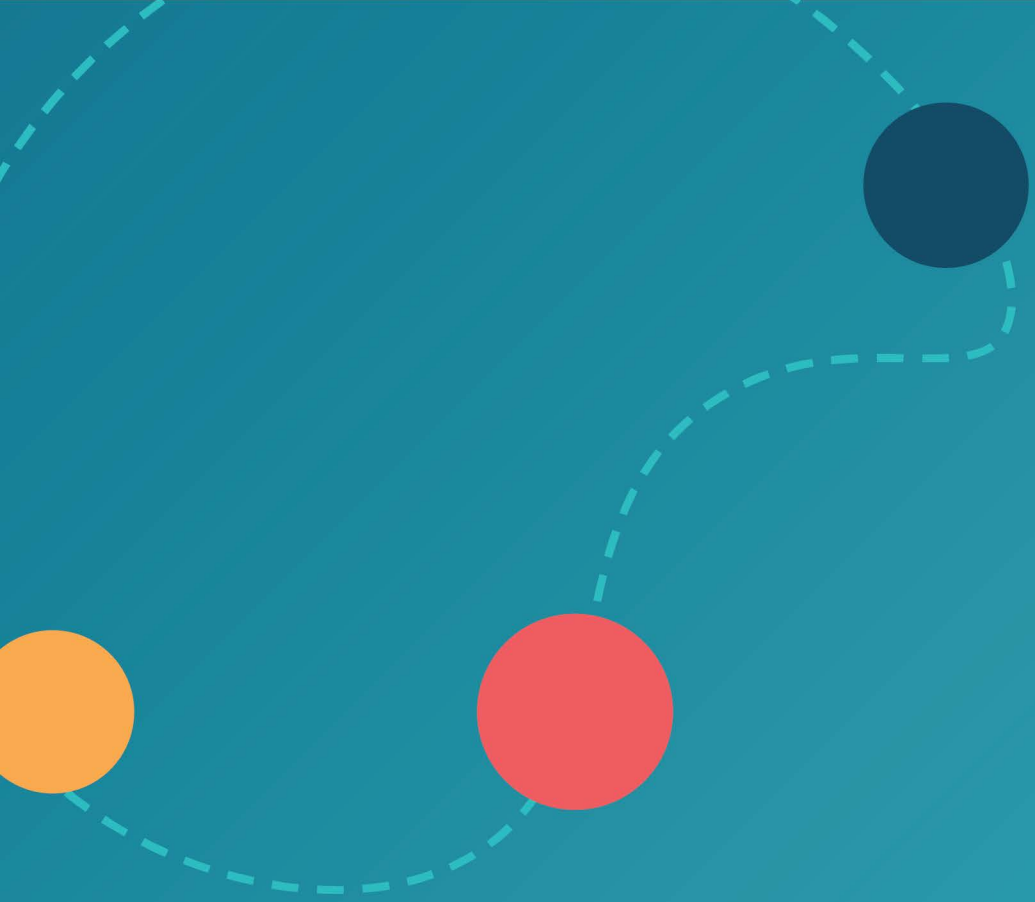
Environmental impacts

Domains of impact	Possible impacts for consideration
The natural environment	How does the innovation impact the natural environment? Think for instance of: • The quality of the local environment • The nature of environment: urban, rural, suburban • The landscape • Bio-diversity
Culture, heritage & leisure	What are the potential effects on culture, heritage and leisure activities? Such as: • Availability of cultural assets • Heritage sites • Events / festivals • Opportunities to participate
Land use	Does the solution make use of land and in what way? • Geographic context • Zoning (agricultural, forestry, marine, industrial, retail, residential, educational, health service, mixed-use) • Conservation
Climate & Energy	How does the innovation impact the climate and/or vice versa? Consider: • Energy conservation • Alternative energy sources • Environmental energy control • Seasonal variation / weather / drainage • Climate change hazards (sea level, heat, cold, floods)
Renewable resources & waste	Is the solution renewable in any way? Can resources be: • Re-used • Reduced • Recycled
Settlement	Does the SI initiave deal with settlement issues in the following areas? • Spatial hierarchy • Zoning • Density • Public spaces
Housing	Does the solution deal with housing in the following areas? • Households by type of accommodation • Quality of housing • Accessibility • Gardens • Heating / Water / Drainage / Electricity / Waste • Internet, broadband
Transport	Are transportation methods and accessibility important? Think of: • Means / modes of travel • Availability / frequency of transportation • Journey times • Safety

Table 5: Domains of environmental impact

Annex II Glossary

CONCEPT	DEFINITION
General Data Protection Regulation	"was drafted and passed by the European Union (EU), it imposes obligations onto organizations anywhere, so long as they target or collect data related to people in the EU." [18]
Innovation	"an outcome of a process, rest on two defining characteristics, a degree of newness of a change and a degree of usefulness or success in application of something new." [1, page 2]
Innovation Ecosystem	"is a multi-level, multi-modal, multi-nodal and multi-agent system of system." [1, page 4].
Responsive	"how natural and artificial systems can interact and adapt." [15, page 3]
Smart buildings	"buildings which integrate and account for intelligence, enterprise, control, and materials and construction as an entire building system, with adaptability, not reactivity, at the core, in order to meet the drivers for building progression: energy and efficiency, longevity, and comfort and satisfaction. The increased amount of information available from this wider range of sources will allow these systems to become adaptable, and enable a Smart Building to prepare itself for context and change over all timescales" [20, page 98-99]
Smart, healthy and age-friendly environments	"a concept intended to draw the attention of policy makers, organisations and citizens of the need to better align ICT with built environments that are focused on an enhancement of the major concept areas of People and Places (user-centred design)." [16].
Social innovation	"the design and implementation of new solutions that imply conceptual, process, product or organizational change, which ultimately aim to improve the welfare and wellbeing of individuals and communities." [3]



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