NET4 Age-Friendly

D5 Report on effective business and evaluation models

International Interdisciplinary Network on
Smart Healthy Age-Friendly Environments | NET4Age-Friendly

COST Action 19136 (2020-2024)

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EUROPEAN COOPERATION
IN SCIENCE & TECHNOLOGY

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

Today, massive societal changes, such as demography or ageing, and transformative technologies promise that the implementation of Smart Healthy Age-Friendly Environments (SHAFE) is possible through political will, social awareness and vision.

This document offers a suite of evaluation instruments and insights into the business models for advancing the SHAFE implementation and the development of SHAFE ecosystems. The purpose of this deliverable is to provide a way of understanding that innovation is to be embedded also in the evaluation and business models in order to advance technological innovation, the change needed in the health and care systems and in the age of urban environments.

There is evidence of significant progress having been made in creating a functioning and successful SHAFE environment. However, this growth is limited by legislative complexities, country differences, and not having a set of toolboxes for conducting proper evaluations of the country/regional SHAFE ecosystems, innovation programs and impacts. Removing the limiting factors would increase the attractiveness of SHAFE for decision-makers, thus creating a more resilient milieu for SHAFE promotion.

The study opens with three key areas of instruments necessary to develop the sustainability of SHAFE:

a) For evaluating the SHAFE ecosystem implementation
b) For evaluating the effectiveness of the innovative programs
c) For Social, Economic and Environmental impacts of SHAFE.

Business Models in SHAFE for integrated health and care and for the new assistive technologies are presented.

Here, the initiation of validation bodies similar to Germany's DIGA (Digitale Gesundheitsanwendungen) to ensure the effectiveness, safety, and user-friendliness of assistive tools as well as the creation of new jobs is encouraged, such as Digital Health Specialists, Community Health Workers, Data Analysts and Health Informatician, or Patient Advocates.

The conclusions section refers to business models and policy and funding recommendations that are relevant for offering the sustainability of the SHAFE ecosystems.

1. INTRODUCTION

1.1 Background, context and aims

As Europe's population continues to age, there is a growing need for new policies, new finance and business models and innovative solutions to address the health and social care challenges faced by the population. This report aims to provide policymakers, governmental strategy consultants and advisors in European countries with a general picture of how the NET4Age-Friendly outcomes could be used to answer the challenges that the health and care system is facing. By integrating technology and innovation, European nations can enhance the quality of life, independence, and well-being of their older citizens, and skill the workforce in health and care areas while simultaneously alleviating the burden on healthcare systems.

The Ageing Challenge in Europe: Europe is experiencing a demographic shift towards an increasingly aged population. According to the United Nations, by 2050, more than 30% of Europe's population is projected to be aged 60 and above. This demographic transition poses unique challenges related to healthcare, social care, and overall quality of life for older people.[1]

Smart Healthy Age-Friendly Environments (SHAFE): Smart Healthy Age-Friendly Environments are designed to empower individuals of all ages by connecting the potential of modern technology, new treatments and therapies and new thinking for health and care systems. These environments promote independent living, social inclusion, and access to health and care services through the integration of various smart solutions, including home automation, telemedicine, wearable devices, and assistive technology.[2]

NET4Age-Friendly, COST Action: is an established international and interdisciplinary network of researchers from all sectors, together with companies, NGOs and Governmental bodies to promote social inclusion, independent living and active and healthy living in society. The network fosters awareness and support for the creation and implementation of smart, healthy indoor and outdoor environments for present and future generations. NET4Age-Friendly further aims to overcome fragmentation and critical gaps at both conceptual and pragmatic innovation levels on responsive, age-friendly and sustainable environments to address European research and policy challenges. [3], [4]

The Smart Healthy Age-Friendly Environments (SHAFE) concept was launched in Europe in 2017. Since then, it has attracted many scientists, policymakers, civil society organisations and public authorities to collaborate and further develop the concept. From a Thematic Network with 160 organisations and networks, it grew to a COST Action with over 700 members from 51 countries (2020-2024) and it will proceed once it is ended towards the integration of members and results in the works of the SHAFE Foundation. It is also exploited and

further developed within several EU-funded projects, such as the Coordination and Support Action SIRENE, co-funded under the Horizon Europe programme.

SHAFE stands for realising digital and healthy social and physical environments for citizens of all ages to foster healthy lives and well-being. SHAFE has a holistic approach and aims to combine the design and building of social and physical living environments with digital solutions based on a person-centred approach at local or regional levels to promote health, wellbeing, community empowerment and a sustainable environment.

SHAFE has its inspiration in the World Health Organization (WHO) concept of age-friendly cities and communities (AFE), launched in 2007.[5] Promoting age-friendly environments (AFE) is an effective approach to address the challenges related to demographic change. While there have been many AFE solutions implemented across Europe, there is a widespread lack of awareness and know-how within local and regional authorities on the value and mechanisms of self-assessing the impact of AFE initiatives so that they can be monitored and improved and more effectively scaled and transferred to other localities and regions.

SHAFE realisation would best mature in local or regional ecosystems, where public authorities, academia, businesses/civil society organisations and citizens collaborate. SHAFE facilitators could be social innovators who fully understand the local or regional situation, can bring parties together and are result-oriented. Public authorities play an important role in the realisation and implementation of SHAFE, either as facilitators, bringing together stakeholders and the administrative pillars of policymaking, creating awareness and support or as well as financers of its implementation. One of the main questions, however, remains and that is: what are the benefits of SHAFE, and how can we measure them? How can you define the impact of SHAFE, and who and what will be impacted?

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The main goal of Working Group (WG) 4's Deliverable 5 (Effective evaluation and business models in SHAFE) in COST Action CA19136 (2020-2024) - NET4Age-Friendly is to analyse current business models, policies across different countries, public and private advocacies, and funding opportunities. Deliverable 5 also will be used for the future development of the D12 module on "policy, funding and business models for the Reference Framework". The joint aim is to create effective relationships with policymakers, public bodies, and private organizations. The WG4 is also dedicated to consolidating and enhancing existing knowledge and examples to develop efficient business and evaluation models. This activity will ensure quality training and proper dissemination, guaranteeing the Action's future progress.

In detail, the WG4 aims to facilitate capacity building, promote interdisciplinary participation, encourage knowledge exchange, and foster cross-European interdisciplinary research capacity. It also aims to improve

cooperation and co-creation with cross-sector stakeholders while introducing and educating scholars on the implementation and sustainability of Smart Healthy Age-Friendly Environments (SHAFE).

1.2 Structure of the report

After the Introductory part which present the Background, context and aims of the report, as well as the methodological aspects, the report is structured in two parts. The first one discusses the Evaluation Models in SHAFE, while the second one, the Business Models in SHAFE.

The first part opens with a discussion on the future research topics in in health, care and age-friendly environments and it emphasises the idea that every technological innovation should be accompanied by social innovation in order to shape social change. The topics have been identified through employing topic modelling and clearly show that there is a quest for a) well-being through community and housing environments supported by technological applications and b) interdisciplinarity is needed. It concluded with an instrument for evaluating SHAFE models, which is created starting from the framework of David Isenberg in analysing entrepreneurial ecosystems, more specifically its pillars, but further adapted through its dimensions and variables, to the SHAFE ecosystem.

Evaluation of Innovation Funding focuses on four mechanisms which can improve the success rate for Innovation Programmes. It addresses each mechanism: a) knowledge sharing and collaboration, b) embedding social innovation into the Project ambition, c) Developing Matrix Management, and d) the need for toolboxes. And it concludes with a tool for Innovation Programs evaluation.

The last part of the Evaluation Models in SHAFE presents an instrument for SHAFE impact assessment: SEE-IT. Social, Economic and Environmental Impacts of SHAFE and it discusses the implications towards ex-ante and ex-post evaluation on SHAFE.

The last part, the Business Models in SHAFE presents a suite of business models relevant to integrated health and care pathways and assistive technologies.

In Conclusion, Business models, Policy and Funding Recommendations are offered for developing new business models relevant to the existent SHAFE challenges implementation.

The NET4Age-Friendly network has been conscientiously working to assemble a robust knowledge base that is composed to serve as a valuable resource for policymakers, business strategies and governmental bodies in shaping the future of inclusive design, digital innovation, and Smart Healthy Age-Friendly Environments (SHAFE). We have designed some recommendations on how policymakers and other advisors can effectively utilize the knowledge base to influence their strategies and policies and emphasize the distinct sides of the knowledge base, focusing on its two key components.

1.3 Methodology and data sources

SHAFE is a multidisciplinary concept. And the concept of SHAFE's acceptance and adoption is growing steadily worldwide. This time marked the beginning of a growing interest for coupling ICT and health, as well as environmental and well-being. Hence, innovation at the intersection of ICT, health and age-friendly environment is now a major focus for industry policy in developed countries.

However, existing approaches in the evaluation of innovation in health/ ICT or age-friendly environments are proving limited effectiveness because they act distinctively. Moreover, there is a need to contribute to facilitate tech transition of classic health business models to societal impact, health benefits and new business economic models in an innovative approach Hence, we will take a holistic approach, focusing on the new emerging research themes relevant to SHAFE and their roadmaps into the society.

For the SHAFE successful adoption and implementation at the societal level, we need to better understand how to evaluate and develop new business models in order to inspire, generate and develop SHAFE ecosystems.

By employing topic modelling, we will gain insights into the underlying themes and concepts embedded in the D4 report and other relevant documents under investigation relevant to SHAFE.

Hence, we aim to demonstrate, by employing topic modelling, how we can:

a) identify new frontier topics relevant to SHAFE and manage them effectively
b) create solid roadmaps to achieve effective processes and growth within SHAFE ecosystems.

We will identify what are the new emerging topics at the intersection of smart, health and age-friendly environments, as well as how we can boost innovation to successfully implement SHAFE.

In conclusion, by employing topic modelling, we contribute to increasing the effectiveness of the evaluation of the current programs in innovation and to identifying new effective business models. Once we identify and generate the new relevant topics and innovations we will couple the results with business modelling in order to boost SHAFE ecosystems. The findings are to be used by decision- makers to improve the programs' practice or revise public policy and to inform how effective business models can be generated, boosting SHAFE successful implementation.

1.3.1 Topic and innovation modelling for SHAFE

Topic modelling is a method in social sciences which leads to the identification of emerging themes (e.g. technologies, societal needs) that bring valuable intelligence to businesses and countries determining research and development priorities.

The method can be further coupled with innovation modelling, which shows how research can be transformed into innovation based on a deep understanding of the societal needs related to SHAFE - which have been previously identified through topic modelling.

The aim is fourfold:

Specific Objective 1. To identify emerging (frontier research) themes relevant to SHAFE by employing topic modelling.

Specific Objective 2. To inspect into the effectiveness of current programs/ roadmaps related to promoting SHAFE (effectiveness of the European and/ or national programs which ingrain the themes identified at SO1).

Specific Objective 3. Based on the outputs from SO1 and SO2, to generate a roadmap for innovative projects relevant to SHAFE with a special focus on healthcare projects.

Specific Objective 4. Harmonising the outcomes of SO1, SO2 and SO3 in order to inform on business models.

There is a close interplay between topic modelling and innovation modelling. The first (SO1) identifies new emerging topics relevant to SHAFE, having a more theoretical nature, while the second (SO2 and SO3) offers us the roadmap from these new identified topics to implementing SHAFE (SO4).

Results

- Identification and tracking of emerging trends, frontier research or popular topics relevant to SHAFE.
- Find relevant information related to new disruptive innovations/ new specialisations/ new jobs/ new frameworks, perspectives or approaches or changed paradigms.
- Optimizing the Results of Innovation Programmes relevant to SHAFE.
- Informing on the Business Models.
- Generate a roadmap for programmes/ projects relevant to SHAFE.

1.3.2 Methodology for business models in architecture and urban nature-based solutions

Health and care and urban architecture are related in many ways, as the design of the built environment can affect the physical, mental, and social well-being of people. Some of the aspects of urban architecture that can influence health and care are:

- Identify the most relevant and emerging issues for older adults and their caregivers, such as chronic diseases, mental health, social isolation, or accessibility.
- Analyse the opinions and preferences of older adults and their stakeholders, such as health professionals, policy-makers, or service providers.
- Evaluate the impact and effectiveness of interventions and policies that aim to improve the quality of life and well-being of older adults.

Mapping-out of case studies and experiences is a method in urban sciences which leads to the identification and organization of crucial themes which boost valuable intelligence on environments, businesses, and people in a specific area, and determine research and development priorities through collecting, connecting, integrating, and enriching themed databases. Mapping-out shows how collected data can be transformed into the next innovation based on a deep understanding and then organising of the societal needs related to SHAFE. Therefore, we will investigate some of the emerging business models for Architecture and Urban Nature-Based Solutions coming from the EU Horizon 2020 experience, highlighting the intersections with smart, healthy, and age-friendly environments. In such a way, we can boost innovation to implement SHAFE fruitfully. The following effective business models have been selected and clustered through data collection.

2. EVALUATION MODELS IN SHAFE

2.1 Evaluating SHAFE ecosystems: From technological to social innovation

Identifying frontier research themes relevant to SHAFE

Frontier research is a term that refers to research that pushes the boundaries of knowledge and creates new scientific discoveries and innovations. Frontier research is often characterised by high risk, high reward, interdisciplinarity, and originality. Frontier research can lead to breakthroughs in various fields, such as medicine, biotechnology, nanotechnology, quantum physics, artificial intelligence, and more. Frontier research is supported by various funding agencies and organizations, such as the European Research Council, the National Science Foundation, and the Frontiers Research Foundation[12]. Frontier research also requires collaboration and communication among researchers, as well as engagement with the public and policymakers. Frontier research can have significant impacts on society, economy, and environment, as well as inspire future generations of scientists.

Frontier research topics in health, care and age-friendly environments[6] are those that explore the evidence for environmental influences on older adult health and well-being, identify modifiable physical and social factors for healthy ageing, and offer recommendations for future research and policy interventions towards ageing-friendly environments[12]. Some of the main themes of these topics include:

- **Active living/ageing:** how to promote physical activity, mobility, and independence among older adults in various settings, such as urban, rural, and residential environments.
- **Health-related outcomes linked with community environments:** how to assess and improve the quality of life, mental health, cognitive function, and chronic disease prevention and management of citizens in relation to their exposure to environmental hazards, such as air pollution, noise, and extreme weather.
- **Housing environments:** how to design and adapt housing environments that are accessible, affordable, comfortable, and supportive of citizens' needs and preferences.
- **Technological innovations and novel applications:** how to use and evaluate new technologies, such as smart devices, sensors, robots, and telehealth, which can enhance citizens' health, safety, and social connectedness.
- **Methodological approaches:** how to develop and apply innovative methods, such as big data, artificial intelligence, and citizen science, which can advance the research and practice of ageing-friendly environments.

- **Positive youth development, mental health, and well-being:** how to foster the optimal development and well-being of younger people across diverse contexts and cultures, using interdisciplinary perspectives from psychology, education, sociology, and public health[1].
- **Ecosystem ecology from a community perspective:** how to understand and manage the interactions and feedback between ecological communities and their environments, using interdisciplinary approaches from ecology, biogeochemistry, remote sensing, and social sciences[2].
- Improving **interdisciplinary research in well-being**: how to unify the philosophy and psychology of well-being, using an inclusive approach that integrates normative and empirical aspects of well-being research[3].

Key topic: Well-being through community and housing environments, supported by technological applications.

These frontier research topics require interdisciplinary collaboration and communication among researchers from different disciplines, as well as stakeholders from policy, practice, and civil society. Interdisciplinarity can enhance the quality, relevance, and impact of well-being research, by bringing together diverse perspectives, methods, and data sources, and by addressing the gaps and limitations of single-disciplinary approaches[4]. Interdisciplinarity can also foster innovation and creativity, by generating new ideas, questions, and solutions that transcend disciplinary boundaries.

Identifying top funded topics in health &care are through topic modelling

- **mRNA COVID-19 vaccines**: how to develop and distribute vaccines that use messenger RNA (mRNA) technology to combat the COVID-19 pandemic.[7]
- **NTLA-2001**: how to use gene-editing technology CRISPR inside the human body to treat a rare genetic disorder.[7]
- **Advanced Research Projects Agency for Health**: how to create a new entity that can accelerate the pace of innovation and achieve breakthroughs in treatments for diseases such as cancer, diabetes and Alzheimer's.[7]
- **Wayfinding project**: how to create retro-inspired murals that help people living with memory loss confidently navigate their neighbourhoods.[7]

- **Allocation of National Institutes of health funding by disease category**: how to analyse and compare the funding patterns of the largest public funder of health research in the world.[8]
- **Ecosystem ecology from a community perspective**: how to understand and manage the interactions and feedback between ecological communities and their environments.[9]
- **Improving interdisciplinary research in well-being**: how to unify the philosophy and psychology of well-being, using an inclusive approach that integrates normative and empirical aspects of well-being research.[9]
- **Positive youth development, mental health, and well-being**: how to foster the optimal development and well-being of young people across diverse contexts and cultures.[10]
- **Deafness and other communication disorders**: how to prevent, diagnose, and treat hearing loss and other communication problems.[10]
- **Drug pricing reforms**: how to address the rising costs of prescription drugs and ensure access and affordability for patients.[11]
- **Genomics:** This trend involves using the analysis of genetic information to understand, diagnose, and treat various diseases and conditions. This can enable more precise and tailored healthcare interventions, as well as prevent or cure diseases that are currently incurable.[12]
- **Immersive technology:** This trend involves using virtual reality, augmented reality, and mixed reality to create immersive and interactive experiences for healthcare purposes, such as education, training, therapy, and entertainment. This can improve the engagement, motivation, and outcomes of healthcare users and providers.

The need for interdisciplinarity in health and care

Identifying some of the future research topics in care through topic modelling:

- **Care coordination and integration**: This topic involves exploring how to improve the quality, efficiency, and outcomes of care delivery by coordinating and integrating different services and providers across the continuum of care. This can reduce fragmentation, duplication, and gaps in care, as well as enhance patient satisfaction and engagement[13].
- **Care transitions and handoffs**: This topic involves examining how to ensure safe and effective transitions and handoffs of care between different settings, levels, and teams of care. This can prevent

adverse events, errors, and readmissions, as well as improve continuity and communication of care. [14] [15] [16]

- **Care innovation and technology**: This topic involves developing and evaluating new and innovative models, methods, and technologies of care that can address the current and future challenges and opportunities in health care. This can include telehealth, remote monitoring, digital health, artificial intelligence, robotics, and smart devices.
- **Care equity and access**: This topic involves investigating how to reduce disparities and improve access to quality care for diverse and underserved populations. This can involve addressing the social determinants of health, cultural competence, health literacy, and health policy.

Change in care as we know it is imminent. Technology and social equity are key focus.

2.2 Embedding age urban architecture in social change

Ageurban architecture is a term that refers to the design of urban environments that are suitable and accessible for older adults, as well as intergenerational communities.[17] It aims to create age-friendly cities that promote active ageing, social inclusion, and well-being.[18] Some of the top funded topics in age urban architecture are:

- **Universal design principles**: how to apply the concept of universal design, which is the design of products and environments that are usable by all people, regardless of age, ability, or situation, to urban planning and architecture.[19]
- **Walkability and mobility**: how to improve the walkability and mobility of older adults in urban areas, by providing safe, comfortable, and convenient pedestrian infrastructure, such as sidewalks, crossings, benches, lighting, and signage.[20]
- **Public transportation and accessibility**: how to enhance the public transportation system and its accessibility for older adults, by providing affordable, reliable, and user-friendly services, such as buses, trains, taxis, and ride-sharing, which connect them to various destinations and amenities.
- **Housing diversity and affordability**: how to provide diverse and affordable housing options for older adults in urban areas, such as co-housing, intergenerational housing, assisted living, and home-sharing, which meet their needs and preferences, and foster social interaction and support.
- **Community engagement and participation**: how to increase the community engagement and participation of older adults in urban areas, by creating opportunities and spaces for them to contribute to civic and social activities, such as volunteering, mentoring, learning, and cultural events.
- **Green and blue spaces**: how to create and maintain green and blue spaces in urban areas, such as parks, gardens, rivers, and lakes, which provide environmental, health, and social benefits for older adults, such as nature contact, physical activity, relaxation, and socialization.
- **Smart technologies and digital inclusion**: how to use and integrate smart technologies and digital tools in urban areas, such as sensors, apps, robots, and telehealth, which can enhance the quality of life, safety, and independence of older adults, as well as their digital inclusion and literacy.
- **Urban regeneration and heritage preservation**: how to revitalize and preserve the urban fabric and heritage of older neighbourhoods, by restoring and adapting historic buildings and sites, and involving older residents in the planning and decision-making processes.
- **Climate change adaptation and resilience**: how to adapt and respond to the impacts of climate change on urban areas, such as heat waves, floods, and air pollution, and enhance the resilience and preparedness of older adults and their communities.

- **Age-friendly policies and governance**: how to develop and implement age-friendly policies and governance mechanisms in urban areas, which involve and empower older adults and their stakeholders, and coordinate and monitor the actions and outcomes of age-friendly initiatives.

2.3 Partial Conclusion. Instrument for evaluating SHAFE ecosystems

Increasing funds and resources for innovation is now a major focus of industry and policy in developed countries. The dream for Smart healthy age -friendly environments (SHAFE) is dreamed because of the so far technological achievements. However, while assessing the efforts, existing approaches for adopting the technological promises are proving ineffective. A key player in this context is social innovation.

Hence, the dream for Smart healthy age -friendly environments (SHAFE) can be promoted only if social innovation is embedded in the core strategy of skills training, job creation, and even changing in societal norms and expectations.

Therefore, in order to develop SHAFE ecosystems, we need to evaluate the extent to which the following variables can be embedded, developed and promoted. The bellow framework has been built following D. Isenberg frameworks for entrepreneurial ecosystems and improved and adapted based on the research findings of the current paper.

The ecosystem framework emphasizes that there is no one key factor of success for entrepreneurship or innovation. Instead, it focuses on the interplay between various factors, according to the Babson framework (Isenberg, 2011). Though, even if the ecosystem is portrayed as the network between the components, or successful collaboration between the six pillars, it is never a static organism, that is why it is important to have a continuous evaluation of the ecosystem.

It is recommended to implement the instrument through merging both qualitative and quantitative methodological approaches.

First, a qualitative assessment though focus group is recommended. Two focus groups need to be organised which comprises people from the top political power and from the bottom as well. Each focus group will comprise 7 to 9 people, where people with various expertise, are brought together. Practitioners need to comprise at least 50% of the group.

A quantitative analysis can be conducted through various analyses of the indexes. This approach enables comparative analyses of the indexes on the one hand, and, on the other hand it completes the qualitative assessment.

Pillars	Dimensions	Variables	Criteria evaluation 1 (not at all) to 5 (very strong)
Policy	Leadership	Support	
		Open door for advocate	
		Urgency crisis and challenge	
	Government	Future jobs in health and care and age-urban architecture	
		Tax benefits and other regulatory taxes incentives	
Finance	Financial capital	Social innovation support	
Culture	Success stories	Technology adoption and social change	
	Societal norms	Power Discourse Analysis	
Supports	New governmental institutions	e.g. Germanys DIGA Digitale Gesundheitsanwendungen) to ensure the effectiveness, safety, and user-friendliness of health technologies and tools	
	Non-governmental institutions	Social change promotion	
	Support professions	Technical experts, advisors	
	Infrastructure	Technology adoption success rate	
Human capital	Educational institutions	The development of new skills set	
	Labour	New job creation	

Table 1: Instrument for evaluating SHAFE ecosystems. Adapted after Domains for Entrepreneurship Ecosystem, D. Isenberg (2011), Harvard & Babson.

2.4 Evaluation of Innovation Funding: Increasing the success rate for Innovation Programmes

Lessons from the Design of the European Commission's 1) Health and Care Programmes, such as AAL Programme 2) Common Exploitation Booster & 3) A7 Experts Group for Supporting Innovation, UEFISCDI, Romania.

Takes Away

Needs	Outcomes	Impact/ KPI
Learning from previous financed similar projects	Knowledge sharing among experts	Increase rate of success Increase number of products on the market Increase number of technological transfer operations
Toolboxes	State of the art Technological transfer	Decrease time and resources Teams for TT
Matrix Management		Cost-effectiveness Reducing the time of a project implementation More dynamicity

Table 2: Takes away. Lessons learned. Adapted after A7 UEFISCDI, Romania, Expert Group Work for Technological Transfer and Innovation, 2022.

We have learned that only about 10% or less of breakthrough innovation projects succeed. The large majority are those who lag behind, commonly due to

a) Lack of vision market /misalignment with market needs,
b) lack of support (leading to lack of funding), and
c) not having the right tools and processes in place.

Therefore, it is helpful to understand the role of Financing Programmes for Innovation which can serve as ecosystems.

Collaboration is key to the success of innovation. Innovating or supporting projects within a Programme/ an ecosystem creates access to the communities within, like experts, practicians, academics, researchers, end-user communities, stakeholders in the form of partners and suppliers. Together, these players create an

ecosystem which generates innovations. Though, innovations are born and further succeed only if the right practices are in place to identify, connect, assess and develop ideas and talents in a dedicated innovation chain.

If a Programme would foster a culture of innovation and include projects' experts as well as external innovators outside the Programme in the process, it is more likely to see positive outcomes. Just like R&D teams can no longer solely carry the weight of development to keep up with the market, neither will external solutions last without the support of your employees. Autonomous collaboration between entities/projects in an ecosystem is needed to accelerate innovation.

Mechanism 1. Knowledge sharing and collaboration

Research and innovation funding programmes could design a mechanism through which knowledge to be shared among the financed projects experts and collaborations to be encouraged.

Active and Assisted Living Programme Case study. Since 2009 until the present, 100s of experts from, research, end-users, businesses, management, technicians, have been involved in the AAL Program. However, there was no sharing among the experts of their work with each other therefore any advancement that might have been gained by sharing has been lost.

Hence, a horizontal knowledge transfer could be opportune between different type of expertise: end-user/ technical/ management/ ethics and vertical knowledge transfer across the AAL projects, regardless of when ended, including the evaluators.

There is no training programme on the knowledge/ lessons learned on previous projects or similar funded projects, research and developments which did (not) succeed. Shared Innovation (failures) should be integrated into the Programme.

Mechanism 2. Embedding social innovation into the Project ambition

Social innovation has to be taken into consideration and its roadmap should be foreseen. The current frameworks discourage any change and encourage the alignment with the initial Description of work (DoW).

Mechanism 3. Developing "MATRIX" management

- **A management body** to constantly monitor and evaluate projects development and reduce to minimum the management/ bureaucratic/ administrative work of each project.

- **A marketing body** to ensure the building and implementing of the dissemination and communication strategies for each project.
- **Committees on ethics, technological transfer and medical device regulations** because these are key topics for advancing innovative projects.
- **A pool of end-user organisations actively testing**. Employing co-creation before concept development, while the initial concept bound the whole Consortium to the initial project idea. Some of them can become early adopters in the course of project development.
- **A pool of research organisations,** which can be activated over the project implementation. For example, instruments for field-trial research and validation should be developed after the demo-phase. Systematic and up-to-date investigation of the research results exploitation.
- **Biannual** monitoring and evaluation.

Mechanism 4 The need for toolboxes

A lot of knowledge has already collected, and yet the latest knowledge gained has somehow been reiterated with each new AAL project. A knowledge repository should systematically capture, organize and categorize knowledge-based information relevant to the Programme and deriving from the AAL projects implementation and similar support programs. A systematic investigation of the AAL repositories from the perspective of building relevant repositories to be further embodied in future support programmes in order to benefit from the latest advancements in technology.[21]

a) ***The knowledge repository*** *should be four-fold: 1) impacts assessment, 2) end-user requirements and expectations, 3) technical innovations, and 4) business modelling and research results exploitation.*
b) ***Templates*** *should be advanced for ethics standards and the harmonization of the technological readiness level (TRL – not necessarily appropriate term, but accurate enough),*
c) ***Validated scales and research frameworks****. For example, The System Usability Scale employed in the large majority of the AAL projects, is either not suitable or not recommended as a stand-alone usability metric for eHealth.*[22] *Gerontographics segmentation (segmentation for people aged 65+) can be employed and thus considering the heterogeneity of needs and requirements of the targeted people.*

2.5 Partial Conclusion. Instrument for evaluating the Innovation Programmes

Innovation Programs evaluation:

Pillars	Responsible	Variables	Criteria evaluation 1 (not at all) to 5 (very strong)
Knowledge sharing and collaboration	Funding agency	Knowledge sharing Experts networking Innovation pool	
Embedding Social Innovation	Contractor	Skills set description Training model Social Innovation Stakeholders analysis Pilot analysis	
Matrix management	Funding Agency	Management body Marketing body Committee on ethics Committee on Technological transfer Committee on medical device regulations	
Toolboxes adoption	Contractor	Knowledge repositories, Templates, Validated scales Validated research frameworks	

Table 3: Innovation programmes evaluation, Adapted after A7 UEFISCDI, Romania, Expert Group Work for Technological Transfer and Innovation, 2022.

2.6 SEE-IT. Social, Economic and Environmental Impacts of SHAFE: Ex-ante and ex-post evaluation on SHAFE – impact assessment

In 2015, the AFE-INNOVNET project, funded by the European CIP programme, delivered the **Social Economic Environmental Impact Tool** (SEE-IT).[23] This tool enables national, local and regional authorities to do better ex ante and ex post evaluations of age-friendly environments innovations. With SEE-IT, a conceptual framework was provided that can support cyclic, iterative processes of improvement and fine-tuning. Also, SEE-IT could be used as a tool for co-design partnership that creates support among stakeholders and others.

As the SEE-IT considers the holistic approach of age-friendly environments on social, economic and environmental impacts, the connection with SHAFE is a perfect match. Therefore, we value the SEE-IT as an adequate tool to follow to perform ex-ante and ex-post evaluations on SHAFE measures, programmes, projects or initiatives. The tool enables SHAFE facilitators to organise, assess and analyse the potential impacts of smart healthy age-friendly environments and provides the inclusion of multiple stakeholders, including individual citizens.

Therefore, the SEE-IT has been revisited and transformed into the SHAFE SEE-IT.

Many elements remain the same, such as the cycle of working and the possible impact considerations. Where needed and feasible, the SHAFE SEE-IT has been adapted to achieve a more practical approach that is usable for larger groups of developers, policymakers and facilitators. The SHAFE SEE-IT is tested during the COST Action NET4Age-Friendly Training School in Skopje (26-28 September 2023 | 30 participants) and during the NET4Age-Friendly webinar on October 17th | 32 participants). Based on the findings, the SHAFE SEE-IT was further adapted and refined.

The SHAFE SEE-IT considers the potential impacts of all solutions within the frame of smart healthy age-friendly environments. This could imply broad programmes, such as the revitalisation of communities (construction and social structure) or healthy lifestyles and prevention agendas. Also, smaller-scale initiatives and projects such as digital apps for social connectedness, social workers and coaches in neighbourhoods, home and infrastructure construction and adaptations fit into the SHAFE approach and impact considerations. The SHAFE SEE-IT impacts citizens of all ages, the scope is limited by the geographical level or predefined target group(s) of the programme or initiative.

2.6.1 SHAFE SEE-IT assessment process

The SHAFE SEE-IT process foresees 5 steps to perform the ex-ante or ex-post evaluations.

- **AIM**: bringing the group together and defining the problem, the aim and objectives of what the SHAFE initiative, programme, and project should achieve.
- **SCOPE**: defining the purpose of the assessment and the zero-baseline of the current situation.
- **ASSESSMENT**: phase to consider appropriate impacts in the social, economic or environmental domain.
- **ANALYSIS**: analysing the assessment findings.
- **RESULTS**: defining and presenting the results.

In the following sections, the steps will be further explained. The example of impact assessment of promoting a healthy lifestyle will demonstrate the process. Please be aware that the assessment is simplified to illustrate the working of the SHAFE SEE-IT as such.

AIM

The first step in de process of SHAFE SEE-IT is to bring together the group of stakeholders for the impact assessment. Based on the programme, project or initiative, the group of stakeholders will be defined and invited. A diverse group of stakeholders, consisting of representatives of citizens, science, businesses and public authorities, is most appropriate for the assessment. It is recommended to consider the level of awareness raising and support that the impact assessment can achieve as this will be helpful for the future of the programme, project or initiative.

Programme: a healthy lifestyle of citizens improvement in City A. Project: realisation of accessible and walkable outdoor environments.

Stakeholders: citizens of all ages, shop owners in shopping areas, local university, local authority: health and prevention, urban planning and infrastructure.

The meeting of the group starts with identifying the core problem, the defining of the aim and the objectives the group wants to achieve. This is the most critical part of the SHAFE SEE-IT process as it sets the overall direction and extent for the impact assessment exercise.

Core problem: a growing number of people with overweight due to sedentary lives and unhealthy food consumption. Main aim: reduce the number of people with overweight and support a healthy lifestyle. Specific objectives: (1) To improve the walkability in the neighbourhood. (2) To promote walking. (3) To strengthen social participation in the neighbourhood.

SCOPE

The second step is the definition of the SCOPE of the assessment. Who, what and when will be assessed? The SCOPE starts with the definition of the current situation, the so-called zero-base situation. Additionally, the possible solutions are defined.

Zero-base situation: The neighbourhood counts 17,000 inhabitants living in 5,000 households. The neighbourhood is about 30 years old. When the neighbourhood was built, many young families moved to it. Nowadays, the neighbourhood is mainly inhabited by people who work outside the neighbourhood and pensioners. 15% are children and adolescents, 25% are over 65. Diabetes 2 affects 10 out of 100 older adults. The number of cars is 7,000. The offer of public transport has been decreased to 1 bus per hour and it only drives from the shopping mall to the centre of the city. The available infrastructure is strongly focused on cars. Walking and cycling are therefore hardly feasible in the neighbourhood. The neighbourhood counts 10 fast food restaurants that have 1,000 customers each day.

Solutions: (1) Restructuring of the infrastructure to give space to walking and cycling by providing broader sideways. (2) Create a bonus system by providing free tickets for theatres, playgrounds, cinemas. (3) Create community groups for walking and joint healthy cooking.

ASSESSMENT

For the assessment phase, we will make use of the lists of potential social, economic and environmental impacts that are presented in the Annex. We assess which impacts are appropriate, and then we jointly define the consequences of these impacts. Thereto we make a list of the impacts.

Next step is to assess the identified impacts by answering the following questions:

1. What is the direction of the impact: is it positive, neutral or negative?
2. What is the intensity of the impact: neutral, strong, very strong?
3. Who or what is directly or indirectly impacted?
4. What is the quantification or monetisation of the impact?

The team of our example defines a series of impacts from the lists in the Annex:

- Social
    - Health & longevity
    - Meaning & inclusivity
    - Quality of social interactions
- Economic

- Public budgets
- Sustainable consumption & production

- Environmental:
  - The natural environment
  - Culture, heritage & leisure
  - Settlement

Impact	Direction	Intensity	Indirect/direct
Health & longevity	Positive	Strong	Citizens – direct
Meaning & inclusivity	Positive	Very strong	Citizens – direct
Social interactions	Positive	Neutral/strong	Citizens – indirect
Public budgets	Negative	Strong	Tax and public administration – direct
Consumption/production	Positive	Neutral	Households and restaurants – direct
Natural environment	Positive	Neutral	Living environment – direct
Culture/leisure/heritage	Neutral	Neutral	Change of habits – direct
Settlement	Neutral	Neutral	Urban setting – direct

Table 4: Assessing the impacts

The next step in stage 3 is the monetisation or quantification of the impacts. The list below indicates the ways and methods to calculate potential impacts. When performing an impact assessment, the team can choose which figures they want to use, also related to the available data and databases.

- **Scale and significance**
  - Scale: how widespread the outcomes and impacts are likely to be. It can be measured by different criteria, such as the number of people or entities affected, the magnitude or intensity of the change, the duration or persistence of the change.
  - Significance: the importance, or value, of those benefits. For example, a new law may positively impact workers' health and safety, but its significance varies depending on how workers value their health and safety and how the law is enforced.
- **Monetisation of non-market impacts**
  - Link the impact to market prices, such as a decrease or increase in hospital admissions or medicine = X €. If market prices are not available, the impact can also be linked to the willingness to pay or the willingness to accept.
- **Costs**

- Setup (initial investments), operational costs (maintenance and services, annual costs of funds, capital investment) and administrative burden (overhead and management costs)

- **Gains and losses**
  - Direct market gains/revenues/losses: changes to patterns and volumes in hospital admissions, medicine usage, home support
  - Indirect market gains/revenues/losses: neighbourhood or housing valuation, number of transport/mobility
  - Total gains/losses over a period: aggregation of gains/losses
- **Non-monetary approaches**
  - **Quality Adjusted Life Years** (QALY): a year of life in perfect health is counted as 1.0. For example, if a patient lived in a situation with a utility of 0.5 or 0.5 QALYs, that person is only experiencing 50% of the possible value of that year. The patient living in less than perfect health for a period of time of one year is valued as much as the value of living half a year in perfect health. An intervention results in a patient living for four extra years rather than dying within one year. In this case, their quality of life would have dropped from 1 to 0.6. The following formula would be generated[24]:
    - 4 years of extra life with a quality of life of 0.6 = 2.4
    - Reduced quality of life in less than 1 year (1 – 0.6)= 0.4
    - QALY value after the intervention = 2.0
  - **Disability Adjusted Life Years** (DALY): counted as years lost. According to the WHO, DALY represents the loss of the equivalent of one year of full health. DALYs for a disease or health condition are the sum of the years of life lost due to premature mortality (YLLs) and the years lived with a disability (YLDs) due to prevalent cases of the disease or health condition in a population.[25]
  - **Healthy Life Years** (HLY): measures the number of quality-adjusted remaining life years per person. Eurostat defined the Healthy life years in the EU at 64.2 years for women and 63.1 years for men in 2021.[26]
- **Monetary approaches**
  - **Cost of Illness** (COI): medical expenses related to illness. The OECD estimates the expenditure by Disease, Age and Gender[27]:
  - **Human Capital**: the eventual loss of future earnings. The Journal of Statistics in Society published in 2008 an illustration of the multiplier-multiplicand method that is often used to calculate the loss of future earnings.[28]
- **Preference Based approaches**

- Value of Statistical Life (VOSL): an economic value on willingness to accept higher or lower levels of risk or how much society would be willing to spend to prevent one unidentified death. A systematic review in 2019 for VSL showed a large variation, depending mainly on the context rather than the method used.[29]
- Value of Statistical Life Year (VOLY): increase of one additional year of life expectancy. This does not say anything about the quality of life.

- **Life Cycle Assessment approach** (LCA): evaluating a product or service's effects on the environment over the entire period of its life. The so-called life cycle costing (LCC) is supported by the European Commission and provides Green business LCC tools on computers and monitors, imaging equipment, indoor lighting, outdoor lighting and vending machines.[30]

Useful databases

- Eurostat: https://ec.europa.eu/eurostat
- European data portal: https://data.europa.eu/en
- World Health Organization, The Global Health Observatory: https://www.who.int/data/gho
- Organisation for Economic Co-operation and Development: https://www.oecd.org/
- United Nations Data: https://data.un.org/
- United Nations Sustainability Development Goals: https://unstats.un.org/sdgs/dataportal
- Municipal, regional and national databases

ANALYSIS

The fourth stage is the analysis of the found impacts. The goal of this stage is to come to a robust conclusion regarding the impacts. If the group is still uncertain, the process should be reconsidered. The findings of stage 3 are under consideration in this stage. The found impacts are compared by weighing them, and defining the options they provide. Also, we analyse which groups of the population, which sectors and which geographical areas are most impacted. Finally, we analyse if the available data is sufficient to draw a robust conclusion[23] [31]

RESULTS PRESENTATION

The final stage of the impact assessment is to present the team' results to the bigger audience, public authorities, initiators or other stakeholders.

Conclusions

The SHAFE SEE-IT is a supportive tool for everyone who wants to perform ex-ante or ex-post evaluations on projects, programmes or initiatives to realise SHAFE. It suggests an impact assessment process in which is defined who and what is impacted, the direction and intensity. Indicators are provided to analyse the impacts in terms of monetisation or quantification. Besides the fact that SHAFE is supportive to define the results of impacts, other positive results are the stakeholder involvement by working in a diverse team and to jointly become aware of the impacts of potential solutions and to make choices.

3. BUSINESS MODELS IN SHAFE

3.1 Integrated health and social care pathways - overview of models

The integration of health and social care pathways represents a transformative approach to healthcare delivery. These models emphasize the importance of breaking down silos between healthcare and social services to provide more comprehensive, person-centred, and efficient care. In this text, we explore various models for implementing integrated health and social care pathways within health and care systems, supported by references.

I. **Collaborative Care Model: t**he Collaborative Care Model focuses on interdisciplinary teams working collaboratively to deliver patient-centered care. These teams typically include physicians, nurses, social workers, and other professionals. They collectively assess and address an individual's medical, social, and psychological needs, ensuring a comprehensive approach to care. This model is particularly effective for patients with complex health and social care requirements, such as those with chronic conditions or mental health issues.[32]

II. **Care Coordination Model: t**he Care Coordination Model aims to improve the alignment of services across various healthcare and social care settings. Care coordinators play a pivotal role in facilitating the seamless delivery of care. They serve as intermediaries, helping patients navigate the complex healthcare landscape, and ensuring that services are delivered at the right time and place. This model enhances care continuity, reduces fragmentation, and is especially beneficial for patients receiving care from multiple providers and across different care settings.[33]

III. **Population Health Management Model: t**he Population Health Management Model takes a population-based approach to healthcare. It involves analysing data to identify health and social determinants, and trends within a specific population. Interventions and services are then designed to address the unique needs of different groups within the population, improving the overall health and well-being of the community.[34]

IV. **Hub-and-Spoke Model:** the Hub-and-Spoke Model revolves around a central hub or care coordination centre from which healthcare professionals coordinate services to various spokes, which can include primary care clinics, specialist offices, and community organizations. This model streamlines care delivery, ensuring patients have easy access to a range of services, thus improving care coordination and accessibility.[35]

V. **Managed Care Organizations (MCOs):** Managed Care Organizations (MCOs) are entities that oversee and manage healthcare and social services. They often contract with healthcare providers, social

services agencies, and other organizations to deliver integrated care. MCOs can be public or private entities and are known for their emphasis on cost-effectiveness and outcomes-based care.[36]

While integrated health and social care pathways offer numerous advantages, they come with challenges, including the need for effective information-sharing systems, collaboration between traditionally separate organizations, addressing privacy concerns, and adequate training and support for healthcare and social care professionals.

The models discussed above represent examples of innovative approaches to implementing integrated health and social care pathways within health and care systems. These models aim to improve care coordination, enhance the patient experience, and promote better health outcomes. Successful implementation relies on the alignment of financial incentives, technological support, and a commitment to person-centred care, ultimately leading to more efficient, effective, and compassionate health and social care. Embracing these models is a promising step towards transforming the healthcare landscape for the better.

3.2 Business models for integrated health and care pathways

European health and social care systems are founded on principles of accessibility and equity, aiming to provide universal coverage and comprehensive care. While they have achieved remarkable progress, challenges such as ageing population and rising health and care costs require ongoing policy adjustments and innovations to meet the evolving needs of European citizens. Policymakers must remain committed to upholding these principles and developing sustainable solutions for the future. The information in this document will contribute to a better informed and better future solution for policymakers.

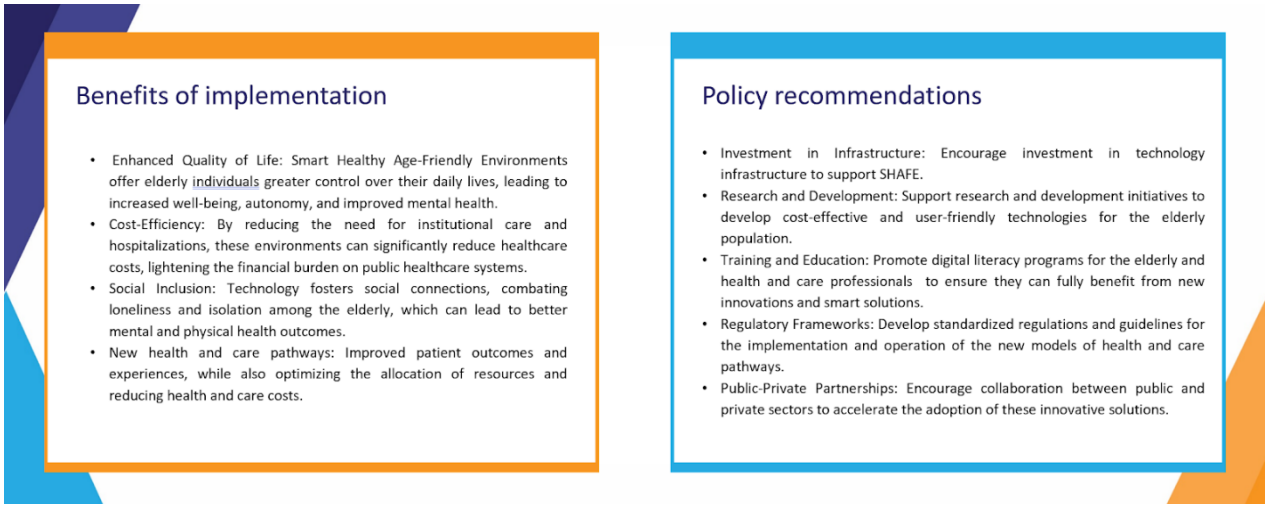

Figure 1: Benefits and Recommendations for Implementation

This chapter will outline the imperative transformation needed in health and care pathways and new business models that governments should take into consideration to successfully implement integrated care person-centred pathways enriched by new technologies. The approaches recommended recognize the importance of patient-centric care, seamless collaboration among healthcare providers, and strategic allocation of resources within health and care budgets. By embracing this holistic perspective, health and care systems can effectively leverage the potential of new technologies to improve the quality of care, enhance patient experiences, optimize health and care expenditures and at the same time follow the SHAFE recommendations.

Health and care worldwide are experiencing a paradigm shift, driven by advances in technology, a rapidly ageing population, and an increasing demand for more patient-centric and integrated care. The integration of these factors requires a significant re-evaluation of healthcare strategies and budgets. The core principles that underpin this transformation are person-centred care and the strategic deployment of new technologies.

I. Integrated health and care pathways: streamline health and social care delivery by optimizing coordination between healthcare professionals, services, and settings such as the environment where the citizen lives. These pathways ensure that citizen receives consistent, well-coordinated care across the care continuum, enhancing efficiency and improving health outcomes.

II. Person-centred care: is a cornerstone of this transformation. It acknowledges the unique needs and preferences of each patient and ensures that care is tailored to them. It emphasizes inclusiveness, equity, empathy, respect, and communication in every aspect of care delivery, aiming to empower patients to actively participate in their health and care decisions.

III. The role of new technologies: new technologies, including electronic health records, telemedicine, wearables, and artificial intelligence, are revolutionising health and care pathways. They offer opportunities to enhance healthcare delivery and improve patient outcomes.

Based on the research done in the NET4AgeFriendly network and SHAFE recommendations the following are key considerations for the integration of technologies in the new health and care pathways:

- **Interoperability:** ensuring that health information systems can communicate and share data across different care settings is crucial. Governments and healthcare organizations must prioritize the development and adoption of interoperable technologies.
- **Telehealth and remote monitoring:** telemedicine enables virtual care delivery, reducing the need for physical visits and increasing access to care. Remote monitoring technologies can track patients' health remotely, facilitating early interventions and reducing the burden on healthcare facilities.

- **Artificial intelligence and predictive analytics:** these technologies can analyse vast amounts of patient data to identify trends, predict disease progression, and personalize treatment plans. This has the potential to significantly improve care efficiency.
- **Wearables and mobile apps:** mobile health applications and wearable devices empower citizens and patients to actively manage their health. Governments should support the development and integration of these tools into care pathways.

VI. Budgetary realignment:

To implement these transformative changes, health and care systems must rethink their way of implementation and become health and care pathways where the budgetary allocations will need to be reconsidered. This realignment of budget, citizens' and patients' needs, and funding ecosystems leads to new business models that governments should take into consideration for the future:

- **Shift from volume to value**: healthcare budgets should emphasise value-based care rather than fee-for-service. Incentivizing healthcare providers to focus on positive patient outcomes rather than the volume of services provided is vital.
- **Investment in infrastructure and new environments**: governments and healthcare organizations must allocate resources to build and maintain robust infrastructure capable of supporting integrated care and the secure exchange of health data.
- **Training and education**: budgets should accommodate training programs to equip healthcare professionals with the skills required to use new technologies effectively and deliver person-centred care.
- **Preventive and home-based care**: shifting budgetary focus toward preventive care and home-based care can alleviate the strain on acute care facilities while delivering more patient-centric services.

The transformation of health and care systems to implement integrated care person-centred pathways enriched by SHAFE and NET4Age-friendly recommendations is essential for addressing the evolving health and social care landscape. Embracing person-centred care and new technologies ensures that patients receive the highest quality of care while optimizing resource allocation within healthcare budgets. This transformative approach not only enhances patient experiences but also drives better health outcomes and more efficient use of resources, ultimately creating sustainable and resilient health and care pathways for patients' future. To achieve this vision, governments, healthcare organizations, and stakeholders must come together to drive necessary policy changes and investments.

The following recommendations offer a comprehensive strategy for the integration of health and social care services, emphasizing the fusion of public and private investment, the support of person-centred care,

reimbursement strategies, and the creation of new job opportunities. These recommendations are designed to enhance the quality, accessibility, and sustainability of healthcare systems for the benefit of all.

I. Integration of public and private investment:

- **Establish funding partnerships**: encourage public-private partnerships to pool resources for health and social care projects. Collaborations between governments, private investors, and research and development grants can amplify funding for innovative initiatives.
- **Incentivize private investment**: create tax incentives, grants, or low-interest loan programs to attract private sector investments in health and social care projects. Ensure transparency and accountability in public-private collaborations.

II. Integration of health and social care services:

- **Regulatory frameworks**: develop and implement regulatory frameworks that facilitate the integration of health and social care services. Ensure that legal and policy barriers are removed to enable seamless collaboration between healthcare and social care providers.
- **Cross-sectoral training**: provide training programs that bridge the knowledge gap between healthcare and social care professionals. Foster interdisciplinary education to enhance collaborative care and support person-centred pathways.

III. Supporting tools for person-centered care:

- **Tool evaluation standards**: establish criteria for evaluating and selecting health technologies and tools that support person-centred care. Create validation bodies similar to Germany's diga (digitale gesundheitsanwendungen) to ensure the effectiveness, safety, and user-friendliness of these tools.
- **Interoperability standards**: promote interoperability between health technologies, electronic health records, and social care systems. Develop and adopt standardized protocols that enable seamless data sharing across the care continuum.

IV. Reimbursement strategies:

- **Value-based payment models**: shift from fee-for-service to value-based payment models that reward healthcare and social care providers for achieving positive health outcomes, reducing costs, and enhancing patient experiences.
- **Bundled payments**: implement bundled payment systems that cover a range of services along the care pathway. These models encourage providers to collaborate in delivering cost-effective care.

V. Training of health and social care workers:

- **Continuous education**: support ongoing education and training programs for health and social care workers. Equip them with the necessary skills to effectively use technologies, implement person-centred pathways, and understand value-based care models.
- **Person-centred training**: incorporate person-centred care principles into the training curriculum for healthcare and social care professionals. Focus on empathy, active listening, and shared decision-making.

VI. New jobs creation:

- **Digital health specialists**: promote the creation of new job roles, such as digital health specialists and care coordinators, who can navigate and leverage health technologies for improved patient outcomes.
- **Community health workers**: expand the role of community health workers who can bridge the gap between health and social care, especially in underserved communities. These workers play a crucial role in supporting vulnerable populations.
- **Data analysts and health informaticians**: develop positions for data analysts and health informaticians who can interpret and derive insights from health data to guide evidence-based decision-making.
- **Patient advocates**: introduce roles for patient advocates who can ensure that individual preferences and needs are heard and met within the care system. These advocates can provide valuable support for person-centred care.

VII. Evaluation of technology efficacy:

- Establish mechanisms for continuous evaluation of the efficacy of health technologies and tools.
- Monitor their impact on patient outcomes, cost savings, and care quality.

VIII. Patient engagement:

- Encourage active patient engagement in care decision-making processes.
- Promote the use of patient portals and health applications to empower individuals to manage their own health.

IX. Standardization of data sharing:

- Advocate for national and international data-sharing standards to ensure the secure and ethical exchange of health and social care data.
- Promote the use of health information exchanges (hies).

X. Research and development:

- Invest in research and development to foster innovation in health and social care.
- Create grants, challenges, and competitions to stimulate the development of new technologies and care models.

XI. Mental health integration: prioritize the integration of mental health services into healthcare and social care systems. Mental health is a critical aspect of person-centred care.

XII. Inclusivity: ensure that all policies and practices are designed to be inclusive and address the needs of diverse and underserved populations, including the older adults, minority groups, and those with disabilities.

3.3 Business models for assistive technologies

We have analysed tens of business models focused on domiciliary care services and business models which would support ageing in place.

Business Model Variations - revenue stream possibilities

- data monitoring within the aim of preventing diseases
- monitoring for safety (falls, getting lost etc)
- technology related products and sensors for monitoring
- services for sensor instalment
- generating reports and analysis
- offering full service (in-home care with medical assistance, cleaning, shopping etc)

We have drawn the following conclusions:

We have found that there are some barriers to penetrate the market that are related to some other factors, and not necessarily to the BM model. Some of these factors are the low adoption rate, the perceived privacy threat, lack of consistent added value (carers do not get valuable insights on the elder situation), results and analyses not being delivered to the carer in a user-friendly format and/or a one-glimpse understanding one.

1. **Most of the services are variations of B2B and B2C and subscription-based services.**

We have found that the B2B model would provide a higher penetration rate, taking into consideration that elder assisting technology would lower the cost per patient/center resident by offloading the manual medical parameters measurements, reducing though the necessary human resource.

Even if technology proved its reliability, the B2C model business is not as successful as the B2B model because for many cases the data which is obtained by the end-user is of no relevance or too detailed or biased towards too medical or too technical content (e.g. data from environmental sensors, medical condition).

Moreover, in the future, Uber-like marketplace for domiciliary care services, revenue based on sales commission from care receiver and care givers would be the most successful business model.

3.4 Job creation and Business & Social Innovation

Job creation in health and care is a vital issue for the future of work and society. According to the World Health Organization, the global health workforce is projected to grow by 40% by 2030, creating 40 million new health jobs. However, a shortage is also foreseen and the number is expected to reach 18 million health workers, whereas most of them from developing countries.

Moreover, job creation is an important factor for the successful adoption of technology in society. Assistive Technology and generally speaking health and care technology, can bring many benefits, such as higher productivity, increased efficiency, safety, and convenience, but it can also pose challenges, such as widening inequality, requesting new training. Therefore, it is essential to ensure that technology adoption is accompanied by policies and strategies that support the creation of new jobs and the reskilling of existing workers.

To foster job creation in health and care, some of the possible actions that can be taken are:

- Investing in the health workforce, by increasing public and private spending, diversifying sources of funding, and allocating resources equitably and efficiently.[37]
- Transforming the health workforce, by adopting new models of care, expanding the scope of practice, enhancing interprofessional collaboration, and leveraging digital technologies.[38]
- Aligning the health workforce with the broader labour market, by strengthening the linkages between health, education, and employment policies, promoting decent work and social dialogue, and facilitating regional and global cooperation.[38]

Future jobs in Health & Care that are expected to grow in demand and popularity:

Nurse practitioner: A nurse practitioner is an advanced practice registered nurse who can diagnose and treat various health conditions, prescribe medications, and order tests. They can also specialize in areas such as family health, paediatrics, mental health, or geriatrics.[39]

Physician assistant: A physician assistant is a health-care professional who can practice medicine under the supervision of a physician. They can perform physical exams, diagnose and treat illnesses, prescribe medications, and assist in surgery. They can also work in various specialties, such as emergency medicine, oncology, or cardiology.[39]

Physical therapist: A physical therapist is a health-care provider who helps patients improve their mobility, reduce pain, and recover from injuries or illnesses. They can evaluate, diagnose, and create treatment plans for patients, as well as educate them on how to prevent or manage their conditions.[39]

Home health and personal care aide: A home health and personal care aide is a worker who provides assistance to people who are aged, disabled, chronically ill, or cognitively impaired. They can help with daily activities, such as bathing, dressing, eating, or taking medications. They can also perform some basic health-related tasks, such as checking vital signs, changing bandages, or administering injections.[40]

Genetic counsellor: A genetic counsellor is a health-care professional who helps people understand and cope with the risks and implications of inherited diseases or conditions. They can provide information, guidance, and support to individuals or families who are affected by or at risk of genetic disorders, such as cystic fibrosis, Huntington's disease, or breast cancer.[41]

To become a genetic counsellor, you need to have a bachelor's degree and a master's degree in genetic counselling from an accredited program.[42], [43] You also need to pass a certification exam from the American Board of Genetic Counselling.[43] Some of the courses and skills that are required or recommended for this career include genetics, biochemistry, psychology, statistics, patient advocacy, counselling, and research methodology [42][43] [44]

Telehealth specialist: A telehealth specialist is a health-care professional who uses technology to deliver health-care services remotely. They can communicate with patients, monitor their health, provide education, or coordinate care through devices such as smartphones, tablets, computers, or wearable sensors.[45]

To become a telehealth specialist, you need to have some education and training in telehealth, as well as the relevant clinical or technical skills for your role. There are different types of trainings available for telehealth, such as introductory, digital communication, cultural humility, tele mentoring, and specialty courses.[46] Some of these trainings may lead to a certificate or credential, such as the Board Certified Telehealth Professional (BCTP) offered by Telehealth.org.[47] You can also find online courses and programs related to telehealth from various universities and organizations, such as Cornell University.[48] Depending on your state and profession, you may also need to obtain a license or certification to practice telehealth across state lines or international borders.[46]

Biomedical engineer: A biomedical engineer is a professional who applies engineering principles and design concepts to medicine and biology. They can create and improve devices, systems, or processes that enhance health-care delivery, such as artificial organs, prosthetics, implants, or imaging equipment.[45]

In summary, job creation is part of social and business innovation and should be tackled accordingly in order to facilitate societal innovation and technology adoption. Job creation can stimulate business innovation by

increasing the demand for new products and services, providing a larger pool of talent and skills, and enhancing the competitiveness and productivity of firms.[49], [50] On the same par, business innovation can foster job creation by generating new market opportunities, improving the quality and efficiency of existing products and services, and creating new sectors and industries.[50], [51]

3.5 Business models in architecture and urban nature-based solutions

Another specific aim was to explore Business Models for Architecture and Urban Nature-Based Solutions, which were assumed in favour of all kinds of city "users" and -wherever possible- comparing to the main target-topic of the Action: The Age-Friendly Environments.

The project takes on four main objectives, which were pursued through the specific objects (SO) 1-to-4:

- SO1: The first objective is to identify emerging Business Models for Architecture and Urban Nature-Based Solutions that are relevant to SHAFE. This is achieved by employing a mapping-out model.
- SO2: The second objective is to connect and enrich the dataset collected in WG1 with the WG4, which focuses on effective business and evaluation models. The goal is to synthesize existing knowledge and critically assess practices of inclusive design of innovative solutions for SHAFE.
- SO3: The third objective is to develop recommendations for the future development of policy, funding, and business models. This is done after inspecting the effectiveness of current programs/roadmaps related to promoting SHAFE.
- SO4: The fourth objective is to harmonise the outcomes of SO1, SO2, and SO3 to inform effective business models.

3.5.1 Introduction to Architecture and Urban Nature-Based Solutions

Architectural and Urban Nature-based solutions (NBS) offer multiple solutions to urban challenges simultaneously. However, sourcing funding and building good urban policies for NBS remains challenging. As well as realising benefits and vantages is hard, which could keep the attention on their maintaining.

When the European Commission first defined the concept of NBS for societal challenges in 2017, financing was recognised as one of the major challenges to its mainstreaming.

Since 2017, subsequent waves of EU research - and innovation-funded projects have substantially contributed to raising the knowledge base of funding and business models for NBS, particularly within urban contexts. Collaborating and sharing knowledge through an EU Task Force, the first set of EU projects laid important

knowledge foundations, reviewed existing literature, and compiled empirical evidence of different financing approaches and the business models underpinning them.

A second set of EU innovation actions advanced this knowledge base, developing and testing new implementation models, business model tools, and approaches. The concept of nature-based solutions (NBS) fosters increased awareness of the multiple values and benefits that nature offers for society, shifting the initial narrative of nature as a mere "cost" to society towards a more suitable meaning as a set of sustainable "solutions" (talking about the five dimensions sustainability: economic, social, ecological, spatial, and cultural) for a broader range of sustainable architectural and urban - as well rural-urban - challenges.[52] This ability of NBS to achieve multiple, parallel (co-)benefits towards different sectors, addressing multiple sustainability challenges at once, can potentially lead to cost-efficient solutions to complex societal problems, starting from the micro-scale (i.e.: the fragile groups of citizens, social segregation, isolation and loneliness, reduced mobility into public spaces, and so on) to the biggest one (such as the rising demand of limited resources, growing urbanisation, biodiversity loss, and climate change, and soils consumption, etc.).[53] Despite the increasing recognition of their strategic role in the shift towards a green and climate-resilient society, several challenges hinder NBS uptake and mainstreaming.

The most significant challenges related to nature-based solutions (NBS) are financial, institutional, and governance barriers. These barriers are linked to specific characteristics of NBS compared to traditional grey infrastructure solutions.

The primary financial challenge faced by NBS is that public sector budgets historically provide a significant proportion of funding for nature-based projects. These budgets are already under pressure, and NBS often competes for funding with other essential public services, such as health or education. As a result, local governments face budget allocation dilemmas and conflicts. Despite growing evidence of the multi-functionality and cross-sectoral benefits of NBS, public budgets for NBS investment are often insufficient to mainstream their use.

Responsibility for NBS planning and implementation usually lies with a single public sector department or agency, such as planning or greening. While these departments demonstrate high levels of knowledge and cultural support for NBS, they often lack knowledge of effective business models for NBS. This knowledge gap leads to a reliance on existing (public sector) funding channels and a lack of confidence in experimenting with alternative financing approaches.

Conversely, the financing/economics departments of public sector organisations hold a high level of knowledge about the public sector and hybrid financing instruments but lack knowledge of the multiple value propositions of NBS and the potential to capture such value[54], as well as in sensitivity toward the relevance

of the theme. Therefore, a major challenge identified is the need to develop capacity-building tools to increase knowledge and awareness of NBS business models across stakeholder groups, both in public sector agencies and with external stakeholders.

An overview of NBS cases in Europe revealed that local authority's budgets represent the lion's share of investment in NBS, although a relatively high incidence of hybrid financing of NBS is also documented.[55] Private investment in NBS is still low, amongst other things, due to a lower level of awareness of NBS in the private sector compared with the public sector. The scale of individual NBS projects (often less than 500,000 EUR) is too small for private sector investors, suggesting that a portfolio approach (bundling multiple NBS projects in systems ready for investment) might be needed.

Efforts are being made to determine the value of open and green spaces, within urban contexts mostly, in both monetary and non-monetary terms.[56], [57], [58] However, there is a significant gap between recognizing the value of nature and finding stakeholders who are willing to pay for it, particularly in the private sector. One of the main challenges faced in researching urban NBS is that the benefits are distributed among different stakeholders. Therefore, NBS can only be cost-effective if public and private contributions are coordinated.[59]

Individual stakeholders would be interested in the different benefits of NBS, but trade-offs are rarely considered [9]. Often, investment in NBS does not seem worthwhile when only one or two of its benefits are taken into account. The difficulty in monetizing socio-ecological benefits presents additional challenges for private investors. Furthermore, many NBS fall under the category of common-pool resources or public goods. Although these benefits accrue to multiple stakeholders, the majority of public NBS benefit specific interests.[60] Given the public good nature of many NBS, there is a lack of clarity on investment return/performance, and a lack of widely accepted and implemented indicators that could communicate the social and environmental impact of NBS.[61]

An important challenge in implementing architectural and urban nature-based solutions (NBS) is securing financing for the capital investment phase. Unlike traditional grey infrastructure solutions, NBS value over time but requires ongoing funding for operational or stewardship costs, as shown in the figure below. Therefore, it is essential to generate revenue to sustain ongoing costs as part of the overall business model.

Moreover, long-term business models should acknowledge the transition of NBS governance towards participatory models that involve multiple stakeholders in creating, delivering, and capturing value. This transition requires taking into account the engagement of various stakeholders.

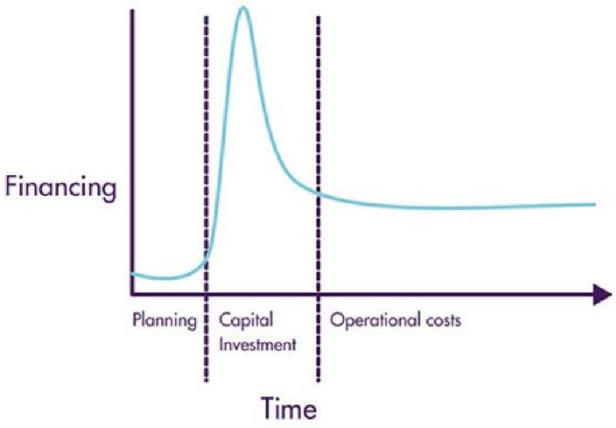

Figure 2: The connecting-nature Heartbeat model on financing nature-based solutions

The challenges associated with natural-based solutions (NBS) include lack of funding, difficulty in capturing their multiple benefits for cost-efficiencies, and the need to involve public-private stakeholders in financing. These challenges have led to efforts to analyse the value proposition, delivery, and capture of NBS through the lens of business model theory.

The business model concept was developed in the 1960s to describe value creation, delivery, and capture models for firms. However, it is now being applied to different domains. One of the most widely used definitions states that "a business model describes the rationale of how an organization creates, delivers, and captures value". In the corporate world, value is traditionally conceptualized as economic or financial performance but even the concept of value has evolved, and companies are increasingly required by society to contribute to the creation of shared and social value.

Recently, several authors have introduced the concept of "business models for sustainability" (BMfS), while others have proposed "sustainable business model archetypes". These strands of literature propose the development of financially profitable value propositions that also reduce negative external effects on the environment and society while creating positive effects.

Around the years 2014-2016, the European Commission launched a call within the Horizon 2020 program for research and innovation to address knowledge gaps and uncertainties associated with NBS. This initiative led to the adaption and application of the concept of business models to the context of NBS. Five years ago, the subject was identified as a critical research need to advance knowledge of business models for nature-based solutions (NBS), given the innovativeness of the concept and the desire to attract increasing amounts of funding, particularly from private actors. As a result, the European Commission's Task Force III working group on "business models and financing for NBS" presented a research initiative to compile and evaluate the advances made by the most important projects, addressing the research question of "How have these

projects contributed to advancing knowledge in the potential application of the business models concept to NBS in order to support building the case for financing and implementation".

Mapping/Exploring NBS Business Models' Key Topics

In this part he following key topics are explored:

(4.1) Importance and role of business models for the implementation and mainstreaming of NBS projects,

(4.2) How business models interact and position with other relevant drivers,

(4.3) An overview of the tools and resources developed across different H2020 projects on NBS business model-related knowledge, tools, and recommendations for application.

Business Models for NBS in Architecture and Urban Design

The first key topic of investigation was the role and value of applying the business model concept to the mainstreaming of NBS. Business models for NBS highlight the value proposition of an NBS project and the elements required to deliver this value. Therefore, the value proposition, value creation and delivery, and value capture are three fundamental elements in the definition of a business model for NBS. The value proposition can be defined as the description of the value that NBS intend to create for citizens/city-users/local government/other stakeholders, and the identification of the needs NBS aim to address.[62], [63]

Value creation and delivery refer to the production of social, environmental, and economic benefits geared towards specific end-users through activities, channels, and partners.[64]

Value capture is about how to earn revenues from the provision of goods, services, or information to users and customers.[65]

These concepts assume even greater relevance in the definition of a business model for the implementation and maintenance of NBS. In fact, NBS are multifunctional and generate several benefits that are received/captured by different stakeholders. Some benefits are captured immediately by market actors (e.g., a decrease in energy consumption and an increase in real estate value due to greening). NBS delivers cost reductions in the long term by reducing weather-related risks, such as flooding, drought, and extreme heat. These and other benefits, such as the aesthetic and psychological value, leveraging social cohesion, and the reduction of health risks, are not fully captured by markets. Connecting Nature and other projects have shown the multiple benefits generated by nature-based enterprises involved in the implementation of NBS—both economic benefits (such as jobs and wealth creation) and non-economic benefits (such as environmental

education or community engagement).[66] In other words, the positive and negative externalities generated by NBS are not internalised by market prices. In light of this, it is difficult to involve private stakeholders in the financing of NBS, and consequently, the most widely diffused business models attribute a leading role to public authorities either through a direct (e.g., involvement in the design/provision/delivery of the solution), or indirect intervention (e.g., setting up the regulatory framework that enables the NBS). In this respect, public authorities can try to remedy market failures through policy instruments aimed at valuing the benefits generated by NBS. The inclusion of the social and environmental value generated by NBS can help articulate business models in which the prevailing public financing model stimulates private investments; for example, the public authority allows a return on the investment through fiscal instruments (e.g., fees, charges, taxes).

The concept of public value for NBS projects is multi-faceted since it comprises different types of values. This value can benefit different stakeholders, each with their specific interests and motivations, and it can be delivered over different periods.[67]

In the H2020 Naturvation project, eight business models for urban NBS were derived based on empirical evidence from 54 in-depth case studies of urban NBS across 18 cities, of which 12 were in Europe (see the table below).[68], [69] Analysis of these cases showed that multiple business models often jointly support the funding of a single NBS and that value propositions were directed at different stakeholders.[69]

A subset of urban NBS is edible city solutions (ECS) studied by the EdiCitNet project, which includes all forms of productive urban landscapes. Edible City Solutions is a wide scope of measures that leverage the city's regeneration, whether building-related or contributing to visibility and education. ECS suffered from their status as a leisure activity (in Western Europe) initiated by private actors, lacking administrative, or municipal support and acknowledgement.[70] In Europe, peri-urban agriculture mostly supports household income, combining self-consumption with sales in the local market.

The EdiCitNet project examined clustered ECS along a value chain and researched different business models for different value propositions. A major project aim was to consolidate and stabilise ECS in their different maturity stages, if necessary, or to enlarge their portfolio of value propositions. The project distinguished four value propositions of ECS.

Business Models	Description
Risk reduction model	The risk reduction model reduces financial risks by building resilience towards adverse environmental events through infrastructure changes.
Green densification model	The green densification model increases real estate value through greening cities.
Urban offsetting model	The urban offsetting model captures monetary flows from negative environmental impacts, re-routing this to re-invest into urban nature.
Green health model	The green health model employs active involvement with green spaces to improve citizens' physical and/or mental health.
Local stewardship model	The local stewardship model empowers citizens and local businesses to foster nature in their local area by offering their resources (money, time).
Vacant space model	The vacant space model facilitates the well-being of citizens through low-cost access to underutilised terrains.
Green heritage model	The green heritage model enables preservation and utilisation of pre-existing natural heritage sites through recreational access.
Green education model	The green education model facilitates the environmental education of (often young) citizens, building a culture of connectedness to nature.

Figure 3: Business models for urban nature-based solutions

Categories of ECS Value Propositions	Description
Services for production	Preparational services and products for soil, substrates or intangible goods such as knowledge exchange and training.
Production of crops	The most important one is still urban agriculture; the production of crops in cities is not limited to soil.
Harvesting and communities	Services around harvesting and communities have specific business models based on particular categories and typical shaping.
Knowledge, digital, and training	Outreach of ECS have special approaches.

Figure 4: Categories of ECS value propositions

The Urban GreenUP project analysed the definition and adoption of business models for nature-based solutions (NBS) in cities by conducting a literature review of best practices and case studies in EU and non-EU cities. The aim was to understand the structure and characteristics of successful NBS business models. To analyse the business models, an assessment framework was defined, consisting of two main blocks. The first block was related to general information about the project, including its objectives and the main challenges faced by the city. The second block was related to the business model itself, including the stakeholders involved, the value proposition, delivery and capture, cost structures, and revenues, among others. The Urban GreenUP project conducted a stakeholder perception analysis, which showed that the definitions of value proposition, delivery, and capture could vary based on the considered NBS and the involved stakeholders. The analysis and identification of the values generated through the implementation of NBS in cities revealed hidden values, helping to define business models that can internalize the positive externalities of NBS. Table 3 describes the values attributed to different types of NBS by different stakeholders.

Stakeholders	Value Proposition	Value Delivery	Value Capture
Values associated with green roofs and walls			
Public administration	Reduction of heat island effect	Creation of milder microclimate	Improvement of citizens health and comfort
Firms	Implementation of investments	Business opportunities (for utilities, it depends on public incentive schemes)	Increase of revenues
Citizens	Energy savings	Reduction of heating and cooling systems	Savings in energy bill
Values associated with sustainable urban drainage systems			
Public administration	Reduction of water run-off	Decrease in flooding events	Reduction of restoration costs
Firms	Protection of natural assets	Decrease in flood events	Insurance value
Citizens	Protection of residential areas	Decrease in flood events and well-being improvement	Improvement of overall neighbourhood and increase of property value
Values associated with tree planting			
Public administration	Reduction of the heat island effect	Increase of urban areas' liveability	Health improvement
Firms	Improvement of brand recognition	Business opportunities	Increase in area attractiveness and in the economic activity
Citizens	Tree cover in residential areas leading to health, aesthetic, and biodiversity benefits	Health benefits	Improvement of overall neighbourhood
Values associated with parks			
Public administration	Regeneration of neglected areas	Improvement of urban well-being and social cohesion	New businesses and new economic opportunities
Firms	Implementation of investments	Business opportunities (for utilities, it depends on public incentive schemes)	Increase of revenues
Citizens	Recreation	Improvement of health and well-being	Increase in value properties
Values associated with edible city solutions			
Public administration	Urban regeneration and social impacting edible space	Integrative and inclusive social impact in the urban area	Cost–benefit of micro and macro-economic harness
Firms	Resilient economic activities from small-scaled solutions to larger investments	Business and social entrepreneurship opportunities	Independent local economic structure providing local identity and socio-economic welfare
Citizens	Social cohesion and opportunities for interaction within and with nature in cities	Social well-being and areas of trust, neighbourhoods, and communities	Ecosystem and socio-economic services

Figure 5: Value attributed to NBS across three stakeholder categories mentioned above

3.5.2 Importance of an Integrated Approach to Co-Creation, Governance, and Financing for NBS Business Models at Different Scales

In analysing the critical factors that influence the creation of business models for NBS (Nature-Based Solutions), three important interlinked leverage points were identified mapping across several projects. These factors are co-creation, governance, and financing. This section outlines different project approaches to understand and guide their significance and role while exploring business models for NBS.

Governance plays a crucial role in enabling innovation and generating new ways of collaborating to implement and sustain innovative NBS and achieve economic sustainability. When establishing businesses and innovative start-ups that explore and capitalize on urban nature, it is essential to consider the institutional framework provided by national and local governments. This includes governance systems, political agenda priorities, and institutions.

Governance aims to promote well-being and progress in society through interventions that aim to change the development tracks and behaviour of individual citizens, company actors, and collective actors. These actors include communities and NGOs, economic sectors and business associations, and public institutions. Governance involves networks for agenda-setting decision-making, project development and implementation, and involves business and multiple other societal actors and interests.

Therefore, integrating NBS in public policy and steering requires interventions not only in urban nature but also in the way societies interact with nature. This involves balancing multiple and, at times, conflicting needs and interests of societal actors who have a stake in nature as a provider of solutions either at a societal level or for nature itself. Antagonistic interests in urban nature and issues that can potentially create tension exist and may hinder NBS-based business incubation. These tensions reveal how NBS, from a sustainable business and governance perspective, are social, economic, and linked to the natural environment.

The integration of real-life conditions and politics can be a barrier or a facilitator for the inclusion of Nature-Based Solutions (NBS) in societal responses to great challenges. The transformation to green and sustainable post-carbon societies is now a priority on the agenda of many members, including states and cities. This is driven by a growing number of public policies and projects aimed at achieving the UN Sustainable Development Goal 11 on Sustainable Cities and Communities.

Urban nature is increasingly being considered in the approaches formulated by public authorities, policymakers, and semi-public and private actors involved in governance. Some authors have suggested that to assess funding and business models, it is necessary to study the suitability of governance arrangements and the key actors involved.[71], [72] Therefore, the definition of business models for implementing NBS projects should adopt an integrated approach that studies the actors together with the available resources and their interactions.[73] To maximize the innovative potential of NBS, adaptive public policy with the participation of local businesses and stakeholders is necessary. NBS projects must be adapted to their specific local socio-ecological contexts to increase the chances of successful implementation.[74]

The Nature4Cities project (N4C) aimed to integrate governance, financing, and business dimensions through two approaches: conceptual and operational integration. An implementation model (IM) is defined as "the combination of governance, business, and financial models under which the NBS is planned, developed and

managed".[75] The conceptual integration involved mapping the models based on their suitability for NBS projects and the involvement of government, market, and community stakeholders. Governance, finance models, and market-shaping strategies were clustered to create an IM-integrated typology for decision-making on NBS implementation. The operational approach was constructed using the WHAT-WHO-HOW framework based on the revision of around 50 case studies to support the development of tailored business models for the NBS projects. Sustainable business model patterns were assessed regarding their suitability for NBS projects - adopting the sustainable business model patterns classified by Lüdeke-Freund et al. [76] - and linked with the elements of the NBS-oriented business model canvas. Lastly, a web-based tool (IM preselection tool) offers applicable and adaptable models and patterns that facilitate the building of implementation models tailored to specific NBS projects and their contextual conditions.

The IMs provide decision-makers with more precise and effective strategies that should be co-created with the key stakeholders involved in the NBS project. The IM preselection tool aims to support the process of determining which different governance models are the most appropriate for different financing schemes and defining the appropriate elements for the business opportunity that the NBS project represents, taking into account context conditions.

In a parallel perspective, the REGREEN project applied a conceptual framework of governance architectures for the integration of institutional and governance structures with local cultures for co-creation and adoption of NBS in policy and planning to develop innovative policy platforms on which NBS business initiatives can be maintained and developed with public support and partnerships.

Regarding co-creation, the H2020 project, Clever Cities, piloted a novel co-creation pathway to engage citizens in the design and implementation of a shared governance process for NBS.[77] This approach involved engaging and empowering multiple stakeholders to participate in urban innovation partnerships through the medium of urban living labs. The findings indicated that this approach led to an increase in awareness of the social benefits of NBS while simultaneously providing a mechanism to address spatial, financial, and governance challenges. The findings included a recommendation that such co-creation approaches be embedded in urban planning practices to lead to increased acceptance of shared-governance processes. Lessons learned from this process indicate that co-creation remains a challenge for many stakeholders and that it can be demanding in terms of effort, time, and money.

The need to consider these interdependencies between co-creation, governance, financing, and business model design choices was also found to be crucial within the H2020 NAIAD project. This is critical to ensure the design of an implementation arrangement that not only guarantees the delivery of the NBS project but is also effective in maintaining long-term sustainability in service delivery. NAIAD further developed the Financing Framework for Water Security (FFWS) adapted to the NBS[78], which enables a process of

transdisciplinary collaboration that engages the (infrastructure) financing community and the proponents of the NBS in designing fit-for-purpose project delivery and finance arrangements for hybrid (green/grey) projects.[79] By considering the transaction or project characteristics (financial and technical), the level of service required over time, and the institutional setting in which the project is to be implemented, these stakeholders can come to a shortlist of the most effective implementation arrangements. Guided by key questions and a repository of good practices worldwide, the proponents of hybrid solutions can choose from a wide range of project delivery and finance options. This range varies from purely public governance options to the creation of regulated markets that support the emergence of private initiatives and innovative business models. The four main families of implementation arrangements identified for large-scale NBS for water security are: (a) public procurement (including traditional as well as PPP contracts and even unsolicited private sector proposals), (b) privately driven water stewardship investments, (c) collective investment schemes, and (d) environmental markets.[78] The implementation of a full watershed-scale NBS plan may involve a combination of these different models and may require some minimum institutional conditions for their successful implementation. If some of these conditions are not present, one would need to adapt and tailor them to ensure the appropriate incentives are put in place. Within the FFWS conceptual framework, business models fit into this process of implementation arrangement design as a conceptual or qualitative narrative that may enable private actors to capture value from the main services to be delivered.

Cities and regional authorities are seeking alternative financing solutions to secure additional funding for Nature-Based Solutions (NBS). These solutions involve other actors such as companies, investment funds, insurance firms, and citizens. Recent projects such as GrowGreen and the EU Urban Agenda partnership on NBS have documented such solutions. To raise funds for NBS, several cities have imposed tax increments and established offsetting funds for developers. Some cities have even issued green bonds and ensured that NBS is well embedded into the project selection framework. The range of donation-based instruments is evolving and includes multi-actor funds, crowdfunding platforms, and stewardship programs. Institutional funds and insurance firms are also investing in or incentivizing NBS, while credit lines are being piloted for the incorporation of nature-based elements in public and private urban projects. The Natural Capital Financing Facility (NCFF) of the European Investment Bank is an example of such a facility. However, each financing mode requires a corresponding adaptation of the business model. The REGREEN project will test using crowdfunding for NBS projects with high social value capture. This endeavour will explore citizens" willingness to participate in NBS projects from the selection to co-creation and implementation of the project, and ultimately its maintenance.

Importance of Integrated Planning as a Constraint or Enabler of Governance, Business Models, and Financing for NBS Deployment

Due to their central role in urban development, formal spatial and urban planning instruments are considered both enablers and barriers to the successful implementation of NBS.[80], [81]

Traditional planning approaches in regional and city master plans constrain the restoration, development, and sustainable management of green infrastructures in urban areas.

In response, the mainstreaming of integrated urban planning and adaptive management approaches has the potential for transformative change, facilitating the deployment of NBS and enabling the mobilisation of the resources that support their effective implementation and integration in wider—and prioritised—strategic policy agendas across the traditional silos of planning and policymaking. [82]

Local governments play a key role in the design of projects to transform urban areas sustainably. Depending on the administrative structure in question, many authorities will have responsibilities, resources, and capacity covering urban planning, water supply, sewage networks, wastewater treatment, highways, management of public open spaces, environmental protection, and health. Despite this broad responsibility, urban greening efforts highlight a tendency towards silos and a lack of integration between departments. [83]

To move towards a more integrated approach, urban planning teams play a crucial role. Not only do they have a broad spatial understanding of the urban area in question, but they typically work at the interface of both the environment and the market and thus can explore new forms of green investment.

Integrated spatial and urban planning approaches stress the transformative role of policy and institutional planning in addressing socio-economic and environmental challenges, such as the Sustainable Development Goals compiled by the United Nations. They also hold great potential to foster the development of more sustainable and participatory NBS projects that bring value to local communities. Acknowledging the different planning approaches and systems in place allows us to (i) anticipate potential barriers to the implementation of certain business, governance, and financial models; and (ii) identify opportunities and specific mechanisms that facilitate the articulation of those models.

Barriers to NBS Implementation: Examples of Traditional Urban Planning Models

Some examples of barriers found in the literature are related to land use regulations and restrictions (i.e., Land-Use Heritage Protection), strict sector policies (i.e., water quality), competing land uses, and conflicts between immediate revenues versus long-term sustainable public benefits, taxation schemes over value capture political logics, and distribution of roles and responsibilities over land and administrative silos. Several

projects have found that urban planning codes often leave no space for the development of innovative solutions that can mitigate climate events. In some EU countries, for example, heritage protection rules hinder the development of NBS in areas where they are most needed; that is, in city centres.[84]

Another barrier is the existence of administrative silos in many European cities, thus lacking the integration of financial resources, technical expertise, and strategic insights from the different departments that could contribute to their development.[58] This administrative rigidity further affects the development of innovative forms of governance and business model development that require more flexible planning processes and enabling regulations. They prevent the creation of financial incentives for these green infrastructures to be developed in cooperation with stakeholders external to the city administration.

Potential of Integrated Planning to Allow New Forms of Governance, Market Development, and NBS Investment

Clearing House and GrowGreen projects started from the premise that integrated spatial and urban planning disciplines and procedures are crucial enablers for transformational changes at the national, regional, and local scales, facilitating the deployment of NBS as well as the mobilisation of the resources that support their effective implementation. Indeed, business, governance, and financial models are articulated with formal planning and could be enhanced by tailored planning instruments aimed at facilitating the development of NBS. Clearing House and GrowGreen projects draw on best-practice case studies (see Appendix A), which offer an approach that is both scenario-focused and fully integrated within existing spatial planning frameworks. In these frameworks, environmental and community threats are perceived as interrelated rather than separate urban problems. By involving local communities throughout NBS development, these case studies provide important lessons on the relationship between urban planning, governance, and business models for NBS.

As earlier argued, integrated planning and management cannot be separated from governance, as the processes of planning and implementation involve a wide range of stakeholders. However, there are multiple differences between planning systems, such as regional economic planning (French or Central model), the comprehensive integrated (German or Nordic model), the land use spatial planning and management (British model), and the urbanism tradition (Mediterranean model). Such differences, as analysed by Newman and Thornley (1996) [84] and the EU Compendium (1997) [85], as well as by the literature on planning cultures [86], [87], [88], could lead to specific governance arrangements and particular combinations of business models. Furthermore, this would depend not only on the planning instruments and procedures in place but also on the social, environmental, and historical grounding of urban (and regional) planning and specific

cultural contexts in which planning operates in reality. The GreenSurge EU project is one of the most recent and comprehensive studies in this direction.

In summary, understanding the planning systems and planning cultures in place is utterly important to define the most suitable governance and business models and to anticipate the required changes needed towards flexible integrated and successful planning.

Need for Adapted Tools for NBS Business Model Design and Implementation

As the complexity of NBS business models emerges from research, a need for tools to support NBS project stakeholders in developing business models has become evident and has been acknowledged by the European Commission.[53] This last section categorises the different types of business model support tools that were developed and applied in practice across different H2020 projects.

Three types of tools have emerged covering the following aspects (see Figure 6):

[1] Business model catalogues and examples of good practices to address lack of knowledge and raise awareness of the multiple forms of NBS business models,

[2] Interactive approaches engaging stakeholders in the co-design of business models

[3] Support tools offering more granular approaches to designing and planning business models for NBS, often applied in collaboration with stakeholders using other methods.

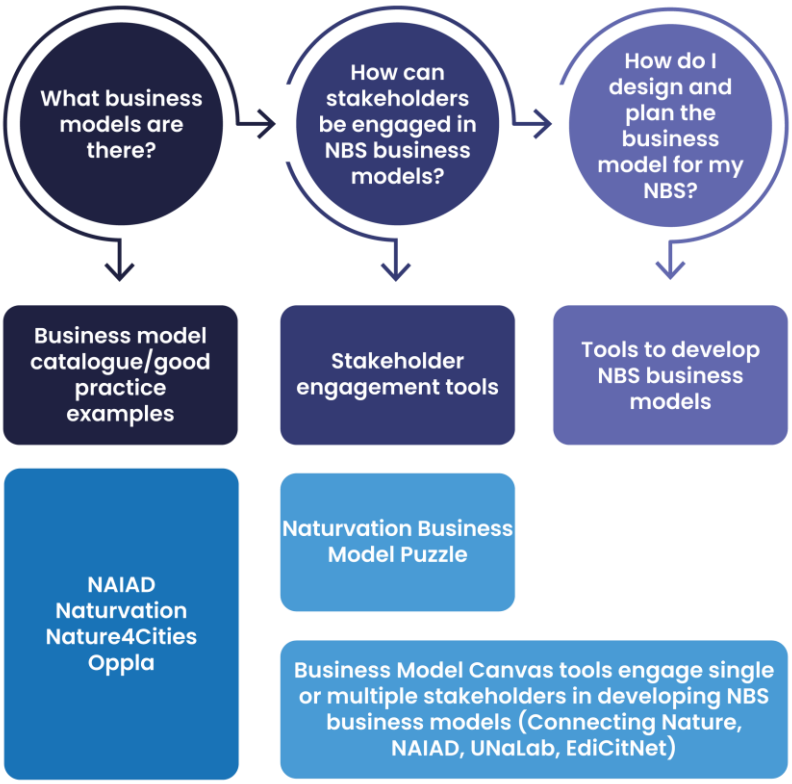

Figure 6: Three types of business model support instruments from H2020 projects analysis

Type 1: Business Model Catalogues and Good Practice Guides

NAIAD"s collection of "International Good Practices in Financing and Funding Nature Restoration" [90] presents a compilation of successful initiatives to fund and finance nature restoration projects, including but not limited to risk reduction projects.[1] The collection is divided into two sections that offer analyses through two different lenses. The first section analyses a set of successful examples of NBS projects through a business model lens by applying the natural assurance scheme (NAS) canvas framework. This NAS framework is a linearised sequence of clusters and steps to intuitively identify and describe all the components of a business model, following a market logic for service provision: from supply through to demand, and leading to impact.[91], [92] The second section reports on a set of successful examples of funding and financing mechanisms for ecosystem restoration initiatives, including facilities and instruments. This collection thus provides an overview of the evidence of existing successful examples of business models, instruments, and facilities for the funding, financing, and implementation of NBS projects.

The Naturvation business model catalogue [68] is an illustrated, practitioner-facing description of the eight different business models found to drive the uptake of urban NBS (see Figure 3 for an overview of the models). The catalogue showcases 16 examples of NBS interventions, providing two illustrations per business model type (one from outside Europe and one from inside Europe). For each example, a short description of the

value proposition, value delivery, and value capture is provided, along with enabling conditions and risks for each case.

Type 2: Stakeholder Engagement Tools

A key challenge for the financing of urban NBS is how to engage multiple stakeholders to contribute to their delivery and stewardship, based on the multiple benefits that can be captured through a single NBS intervention. The Naturvation business model puzzle is an interactive dialogue tool that was developed to facilitate this process, to be used in stakeholder events and workshops to cross silos between stakeholders and identify and build business models in an easy and playful way. It offers a 4 _ 4 puzzle templates for stakeholders to use as a physical artefact for dialogue to identify (1) the types of benefits that are present in a specific NBS they want to deliver and (2) which stakeholders might want to pay for these benefits. Stakeholders can then "mix and match" business models from the Naturvation business model catalogue that fit the uptake of their NBS. The puzzle was tested at many events and is downloadable, including a video explaining how to play the game.

Type 3: Business Model Planning

Business model canvases are commonly used as a starting point for the design and planning of more detailed business models for NBS. These canvases help identify the required components of a business model and organise the information to communicate to investors, promoters, and the public. Some of the NBS-adapted canvases produced within the H2020 framework are the Connecting Nature NBS business model canvas, the NAIAD NAS canvas, the EdiCitNet canvas for ECS, and the Think Nature canvas.

The Connecting Nature H2020 project also originally conceived their NBS business model canvas tool as a stakeholder engagement tool, aimed first at bridging internal departmental silos in public sector organisations through increased understanding of the multiple benefits of NBS, and secondly at facilitating engagement between public, private, and communities based around a shared understanding of the multiple benefits of NBS. The original workshop format has evolved to include support tools, such as wall charts and guidebooks, which are available through the Connecting Nature project website. The simple visual format of the Connecting Nature NBS business model canvas, inspired by the original Osterwalder and Pigneur canvas, led to frequent recognition among business stakeholders and was easily picked up by non-business stakeholders. An important observation from stakeholder engagement workshops was the critical role of an experienced facilitator or bridging organisation with knowledge of NBS in facilitating a productive stakeholder engagement

process.[93] The use of experienced facilitators with good knowledge of business model canvas tools but poor knowledge of the multiple benefits of NBS led to poor outcomes in one city workshop and prompted the elaboration of a comprehensive guide to the NBS business model canvas by the Connecting Nature project.

The connecting NBS business model canvas differs from the original canvas in a number of ways. The central concept of value proposition has been expanded to facilitate a reflection on the broader environmental, social, and economic value propositions associated with NBS. The term Key Beneficiaries has been used instead of Customer Segments, which broadens the consideration of possible "Customers" to include indirect beneficiaries from impacts such as improved air quality. Key Partners and Key Beneficiaries have been positioned side-by-side to reflect the synergies that often exist with NBS between partners and beneficiaries. For example, the community is often the key beneficiary but is often also a key partner in planning and increasingly stewardship. Lastly, Governance is added as a specific dimension to the NBS business model canvas, reflecting the central importance and challenge of governance structures in sustainable business models.[63] The guidebook has been requested by over 150 organisations in more than 20 countries and translated into Spanish by third-party organisations.

Building on the experience of Connecting Nature, the business model canvas approach was also used in the UNaLab H2020 project to plan NBS in the cities of Eindhoven, Tampere, and Genoa. The UNaLab handbook identifies this canvas as "an easy and effective tool to engage the municipalities in the business model analysis of their NBS," and overall found this method "has proven exceptionally useful.[94] However, certain limitations were also noted, particularly the high dependency of the results on the variety of stakeholders involved in the analysis. UNaLab identified that while local government representatives might be the optimal stakeholders to highlight the social and environmental value of the NBS, sometimes they may fail to identify the direct and indirect benefits for the private sector. UNaLab recommended the involvement of both public and private stakeholders in such analysis as essential. The challenges in capturing NBS direct value for the private sector were acknowledged. Approaches such as biodiversity and natural capital accounting may help bridge this gap, providing increasingly robust mechanisms to quantify the multiple values of nature as an asset [43].

NAIAD"s NAS Canvas spans all three types of business model support instruments under the framework of the H2020 NAIAD project. The NAS Canvas framework and tool have been developed as an adapted version of the traditional business model canvas tailored for the analysis and description of business models for NBS, particularly those aimed at disaster risk reduction (DRR). The NAS canvas follows and reflects the flow process of services generated by NBS providing natural protection against climate hazards and how their associated value is generated and captured in both the supply and the demand sides of service provision. It then guides the identification and description of the actors and elements required in this process, thus providing the key

ingredients for the creation of one or several business models to catalyse the provision of the service through the implementation of the NBS. The NAS canvas also builds on the traditional business model canvas by Osterwalder and Pigneur and is enhanced to include elements from the business hub extended canvas and NAIAD"s economic framework to incorporate the particularities of NBS as providers of intangible–common goods. The NAS canvas and framework are presented studies by Mayor et al. [92] which included the application of the tool to describe business models for a variety of NBS-based natural assurance strategies in nine demonstration cases with different scales across Europe. The NAIAD NAS canvas has also been used effectively as a multi-stakeholder approach to co-creating new business models for NBS.

The ECS business model canvas developed by the EdiCitNet project aims to support entrepreneurs and businesses along the value chain of Edible City Solutions (ECS) by offering a tailor-made business consultancy based on a sustainable business model canvas.

This bespoke service will complement the resources of the EdiCitNet marketplace, which analyses common barriers and obstacles for businesses in this sector and serves as an action oriented, multi-sided platform for entrepreneurs and businesses promoting visibility and brokerage. Due to the diverse field of ECS, ranging from urban agriculture to building related installations, a vast pool of different business models and business plans is explored, structured by categories and thematic clusters.

The ThinkNature Handbook focuses on building a business case for financing rather than business models for NBS per se. Natural capital approaches are suggested as a potential framework for building a clear case for investment.[82] The NBS Business Model Canvas is identified as a tool that can be used to assess the impact of NBS, to enable the clear identification of key stakeholders, and to explore how they can be engaged through different governance models. Recognising the complexity of building business models for NBS, ThinkNature proposes a two-step project initiation approach. The first phase, "SITE4NBS", provides an evaluation framework that engages stakeholders in considering the resource investment required for NBS over different scales and timeframes. This high-level overview then feeds into the second "RISE4NBS" phase, which includes four elements: research on risk, regulations, and policy settings, an investigation of different investment options, collaboration with stakeholders and beneficiaries, and an evaluation of socio-economic and environmental impacts. Finally, it is worth mentioning again in this section the fourth more transversal category of tools that considers the interphase between business models, financing, and governance previously presented: the Financial Framework for Water Security developed by the NAIAD project, and the Implementation Model developed by the Nature4Cities project.

Discussion and limitations

This section has identified some of the main challenges constraining NBS implementation, and how these stimulated the consideration and conceptualisation of the business models concept as a potential tool to support NBS upscaling. It has also presented the advances and findings of a set of H2020 projects on NBS business models, unravelling and operationalising the key opportunities and enabling conditions while detecting and highlighting the remaining challenges.

One of the first issues identified across all projects concerned the use of the term “business models” in the context of NBS. Business models are commonly associated with business entities, yet NBS are not enterprises but rather sustainability interventions. While the merit of business models is recognised, particularly in their fit with nature as a “solution” to certain needs, critiques are also found around the use of the term “business models” in relation to NBS. This is due to generating the perception that urban nature could/should be profitable and/or should be privately funded, which raises justice concerns.[95]

Related to this consideration, the question also arises as to whether public actors should refer to a “business model” for NBS, which may further raise expectations of an economic valuation of nature. In reality, many NBS can be identified as public goods (shared by many, difficult to charge for usage) or common-pool resources (limited public resources to be shared among many) that do not lend themselves easily to private sector “pay-per-use” or similar revenue-generating models. Therefore, the use of “business model” terminology should be considered carefully and contextualised appropriately when applied to the case of NBS. Although the merit of applying the business model concept is apparent in the current work, we suggest further theoretical reflection on the appropriateness of the business model concept in the context of sustainable interventions, such as NBS.

On a second reflection, the authors hereafter discuss to what extent the described work on developing, operationalising, and applying the business model concept for NBS by the pool of H2020 projects represented has contributed to partially address and/or understand the following driving challenges.

The first challenge introduced was related to the significant financial needs for mainstreaming implementation, which so far have mainly fallen on public sector budgets, while the private sector remains poorly engaged in NBS investments. In this line, the work done by the projects represented by this author team on exploring, mapping, documenting, and piloting different options and alternatives to support public funding mechanisms that provide guidance towards blended finance options and initiatives. Meanwhile, the participatory and grounded approach of most of these projects through the testing of concepts and tools in case study pilots has also allowed the involvement of private sector actors on the ground with three outcomes: raising private sector awareness and evidence of NBS performance, identifying barriers and levers for private sector involvement, and starting conversations between private and public actors on co-financing NBS. Here, the role of supporting tools as well as co-creation approaches that involve stakeholders have

proven key to realising impact at the intervention scale. A pending issue in this sense is how too upscale such effects for the widespread reach and involvement of the private sector on a higher scale.

A second related challenge was the need to make NBS value explicit and measurable, both in monetary and non-monetary terms, to attract the interest and ex ante perception of benefits from both public and private actors. In this sense, the presented advances on defining, understanding, and classifying NBS value propositions and typologies, as well as creating tools to support the eliciting, describing, and documenting of the value capture process, are important contributions towards making explicit and communicating value to public and private actors and potential investors. These efforts to clearly present the business models should go hand in hand with—and actually capture—the results of previous economic and qualitative valuations of NBS benefits and co-benefits, which in many cases have also been explored and integrated within the H2020 project frameworks.

As a particular example, NAIAD"s NAS canvas integrates the results of the economic assessment of the benefits and co-benefits stemming from the application of the economic valuation framework developed within the project.[96] Nevertheless, it remains true that, even where the economic valuation of NBS can be captured, in many cases, such valuations are not convincing to private investors, as the economic benefits are presented as savings rather than revenue-generating opportunities, and they often accrue in the future (e.g., long-term climate reduction impacts), rendering such investments less attractive than alternative investment projects that present more immediate returns. This well-known preference for short-term rather than distant successes (hyperbolic affective discounting of the future) make the importance of considering alternative valuation approaches even more evident [57], and further research needs to be conducted in this respect. Another area for further research is the exploration of trade-offs between the different value perceptions of various stakeholders.

A third challenge is the focus on financing for upfront capital investment while overlooking the importance of securing financing for operational or maintenance costs, which can constrain the economic sustainability of the project in the long term and deter upfront investment appetite. To address this challenge, it has been acknowledged that generating revenue to sustain ongoing costs should be addressed as part of the overall business model.

The set of tools presented before under Type 3 includes several variations of business model canvases that precisely address the identification and documentation of business models for NBS. These business model tools facilitate the disaggregation and identification of both potential funding streams (aimed at covering the upfront capital costs) and revenue streams along the project lifetime that can contribute to operational and stewardship costs.

Revenue streams are, in fact, one of the key elements of a business model, which in many cases will require the involvement of new beneficiaries (including indirect beneficiaries of NBS co-benefits) willing to pay on a concurrent basis for the provision of nature-based services. The clear need for innovative formulas here has been channelled by most H2020 projects through adding a participatory co-creation component to their tools that ensures a bottom-up approach, giving voice to the project promoters and potential beneficiaries about how they would actually be willing or able to pay to jointly have those costs covered, or to commit resources in another way (i.e., volunteering).

The fourth challenge referred to the silo gaps in the public sector caused by the lack of collaboration across departments and thus the continued dependency on traditional funding channels and approaches. As reflected before, several projects have advocated the importance of considering finance, governance, and integrated planning, with co-creation as a transversal tool to connect them all, as critical to allow overcoming those silos and bringing new actors to the table, including the private sector. The involvement of a multitude of actors in financing NBS presents both benefits in terms of broader stakeholder buy-in and added complexity in terms of governance and business models. Meanwhile, a deeper analysis of the role and potential of urban and land use planning within governmental structures has helped getting argued how, when adopting a more integrative approach, urban and land-use planning teams are well positioned to play an important role as both enablers and conditioners of change due to their broad spatial understanding as well as their work at the interface of both the environment and the market, and thus are able to explore new forms of “green investment”. Urban planners, architects, and landscapers can be key stakeholders to catalyse the integration of NBS within the planning system, with added value from collaboration with other disciplines in a broader set of stakeholders and disciplines brought by co-creation and participatory processes towards integrated planning.

After this overview of the contributions and emerging challenges, the authors acknowledge a series of limitations of the research presented in this article, as well as detected gaps in the overall progress achieved and the need for further work.

Referred to the limitations of this research, one first limitation is the consideration and revision of a subset of the array of H2020 projects currently working on NBS and addressing this business model concept. This limitation leads to some bias and an incomplete overview of the full set of advances achieved within the programme. Linked to the previous one, a second limitation is that the research only considers progress made within the frame of the H2020 projects. The author acknowledges additional advances in knowledge and tools on business models for NBS made by the research community that are not covered in this research. A third limitation is the fact that some of the projects participating in the research are only at a very initial stage; only very preliminary or superficial results could be presented. Nevertheless, the authors” team considered

it worth including mention of those projects and their research focus in order to provide the readers with initial information and the relevant sources where they can follow up on progress and expected results.

Regarding the gaps in the achieved progress, the current research and piloting were mostly carried out in the European urban context, with a few exceptions (NAIAD and RECONECT) contributing at the catchment/aquifer scale, and NATURVATION also including cases from cities outside Europe. Further research is required to develop and juxtapose business models for urban and rural NBS, as well as to embed research from other continents, including the developing world. In this case, we foresee important differences in outcomes. The rural context can potentially provide larger-scale investments, supporting environmental/economic business cases for NBS. Furthermore, other stakeholders, such as farmers, may become involved in the rural context.

As the wave of H2020 projects on (urban) NBS has largely commenced since 2015, evidence and evaluation on the long-term impact of the business model approaches presented in this paper is still lacking. While European funded projects have provided a valuable initial conceptual exploration of the concept and the emergence of typologies and tools to support NBS business model development and are therefore laudable, there remains a lack of empirical evidence to indicate the long-term impacts of such business model approaches. Longitudinal studies measuring the transition in business models, governance, and financing of NBS would provide a much-needed complement to this initial study.

Co-creation, or co-production, is often cited as a prerequisite for the planning and implementation of NBS. This may involve “internal” co-creation bridging departmental silos in municipalities/public bodies (urban planners and other departments, for example) or “external” co-creation bringing multiple public, private, academic, and community stakeholders together to co-create and co-produce NBS. The concept of co-creation would appear fundamental in the development of hybrid financing approaches and collaborative business and governance models, but due to space limitations, there has been limited exploration of co-creation theory in this paper. Further papers that consider business models and financing through the lens of co-creation/co-production theory could provide useful insights for both fields.

Another key topic that interferes with successfully applying business models to NBS is the uptake of valuation tools that are able to account for the plurality of NBS performance.

Natural capital accounting and other tools that are being developed across H2020 projects for NBS play a crucial role in realising business models for NBS by enabling actors to capture, strategize, and communicate NBS benefits.

4. CONCLUSIONS

4.1 Business Model Recommendations

In this deliverable, we explored a diverse collection of business models within the scope of integrated health and social care pathways, assistive technologies, job creation, and business and social innovation, as well as architecture and urban nature-based solutions.

Across the various sectors examined, the innovative business models play a crucial role in shaping the landscape of healthcare, social services, and urban development. From collaborative care models to value-based payment systems, from assistive technology startups to community-based social enterprises, these models represent a variety of approaches aimed at enhancing the well-being and quality of life for individuals and communities.

The integration of health and social care pathways, paired with the adoption of assistive technologies, presents opportunities for more efficient and effective service delivery. By leveraging innovative business models, users, governments, policy makers, industry and a full range of stakeholders can optimize resource allocation, improve care coordination, and enhance the overall citizen and patient experience.

Additionally, exploring business models in architecture and urban nature-based solutions presents an opportunity to reimagine our built environments in ways that promote health, sustainability, and resilience. These models encompass a range of approaches, from green building design and construction to the integration of natural elements into urban landscapes. Moreover, the incorporation of nature-based solutions, such as green roofs, urban parks, and green infrastructure, not only enhances the aesthetic appeal of cities but also contributes to improved air quality, biodiversity, and overall quality of life for residents.

The intersection of business and social innovation offers fertile ground for job creation and economic growth. By coupling the power of entrepreneurship, creativity, and community engagement, new opportunities emerge to address societal challenges and drive positive change.

As we navigate the complexities of healthcare delivery, urban development, and social and care services, it is important that we continue to explore, innovate, and collaborate.

In the emerging and transformative society, we live today, the business models presented and fostering an ecosystem of innovation can support the development of more resilient, inclusive, and sustainable communities for generations to come.

The policymakers and governmental advisors can create a sustainable and integrated health and social care pathway that prioritizes person-centred care, embraces technological innovation, and ensures the well-being of the population based on the recommendations from the business models in SHAFE.

4.2 Policy recommendations

The NET4Age-Friendly network has been conscientiously working to assemble a robust knowledge base that is composed to serve as a valuable resource for policymakers, business strategies and governmental bodies in shaping the future of inclusive design, digital innovation, and Smart Healthy Age-Friendly Environments (SHAFE). We have designed some recommendations on how policymakers and other advisors can effectively use the knowledge base to influence their strategies and policies and emphasize the distinct sides of the knowledge base, focusing on its two key components.

1. **Inclusive Design Knowledge Base developed by Working Group 1**

One of the components of the NET4Age-Friendly knowledge base is the result of the collaborative work carried out in Working Group 1 (WG 1). This segment is dedicated to synthesising existing knowledge that could be gathered by the network members and critically assessing the practices of inclusive design across various domains, including architecture, urban planning, urban design, interior design, technology solutions (ICT), healthcare, and social care. The primary focus here lies in the principles of inclusion, accessibility, usability, and engagement.

Policymakers can draw upon this wealth of information to:

- **Identify best practices**: Utilize the knowledge base to identify and understand the current trends and best practices in user-centred design within specific domains. These insights can be integrated into policies to promote inclusive and accessible design standards.
- **Foster collaboration**: Engage relevant stakeholders and professionals within the domains covered by the knowledge base to drive informed decision-making, ensuring that inclusivity and accessibility principles are upheld.
- **Formulate policies**: The collected data and insights can serve as a foundation for formulating policies that encourage inclusive design and the development of age-friendly environments across urban planning, health and social care, and technology sectors.

2. **Digital Innovation Knowledge Base (Working Group 3)**

The other crucial component of the NET4Age-Friendly knowledge base is derived from the diligent efforts of Working Group 3 (WG 3). This segment encompasses a repository of knowledge connected to digital

innovation and serves as a reference point for understanding state-of-the-art digital technology in Smart Healthy Age-Friendly Environments (SHAFE). It encompasses data domains from diverse sources and aims to provide a versatile resource for understanding the evolving digital landscape.

Policymakers can leverage this part of the knowledge base to:

- **Stay Informed**: Access up-to-date information on digital innovations and technologies relevant to SHAFE, ensuring that policies are aligned with the latest advancements.
- **Drive Technological Integration**: Identify opportunities to integrate emerging technologies into policies related to healthcare, social care, and urban planning for the benefit of populations.
- **Facilitate Evidence-Based Decision-Making**: Use data from the knowledge base to support decision-making processes, crafting policies grounded in empirical knowledge rather than conjecture.

The NET4Age-Friendly knowledge base is an asset for policymakers in shaping strategies and policies for inclusive design and SHAFE implementation. By leveraging the insights and data collected through this initiative, policymakers can drive innovation, foster inclusivity, and ensure that the needs of the ageing population are addressed in an informed and forward-thinking manner. The versatile and flexible nature of the knowledge base empowers policymakers to adapt it to their specific needs and remain at the forefront of digital innovation in the realm of SHAFE.

The NET4Age-Friendly research recommendations together with SHAFE recommendations are a substantial step toward a future where the older population benefits from inclusive, accessible, and technologically advanced environments that enhance their quality of life and well-being.

3. The SHAFE Ontology

The SHAFE Ontology serves as the classification methodology, facilitating the organization and accessibility of information within the knowledge base. Policymakers can navigate this structure to pinpoint specific areas of interest, ensuring that the policies are tailored to the citizen's needs.

4.3 Funding Recommendations

Developing an ecosystem of sustainable funding strategies for Smart Healthy Age-Friendly Environments (SHAFE) is essential for governments seeking to enhance the well-being of their ageing populations. This ecosystem should seamlessly integrate various funding sources with different percentages of how it should contribute to ensuring the sustainability and success of SHAFE initiatives. We exemplify below the ecosystem and for the exercise of this work we have used equal shares, but in a real environment, each country should assess the share that should be given to each component. The analysis for the share that each pillar in the

ecosystem should have could be based on the sustainability pillars: environment, economy and social, together with the SDG goals and the national goals.

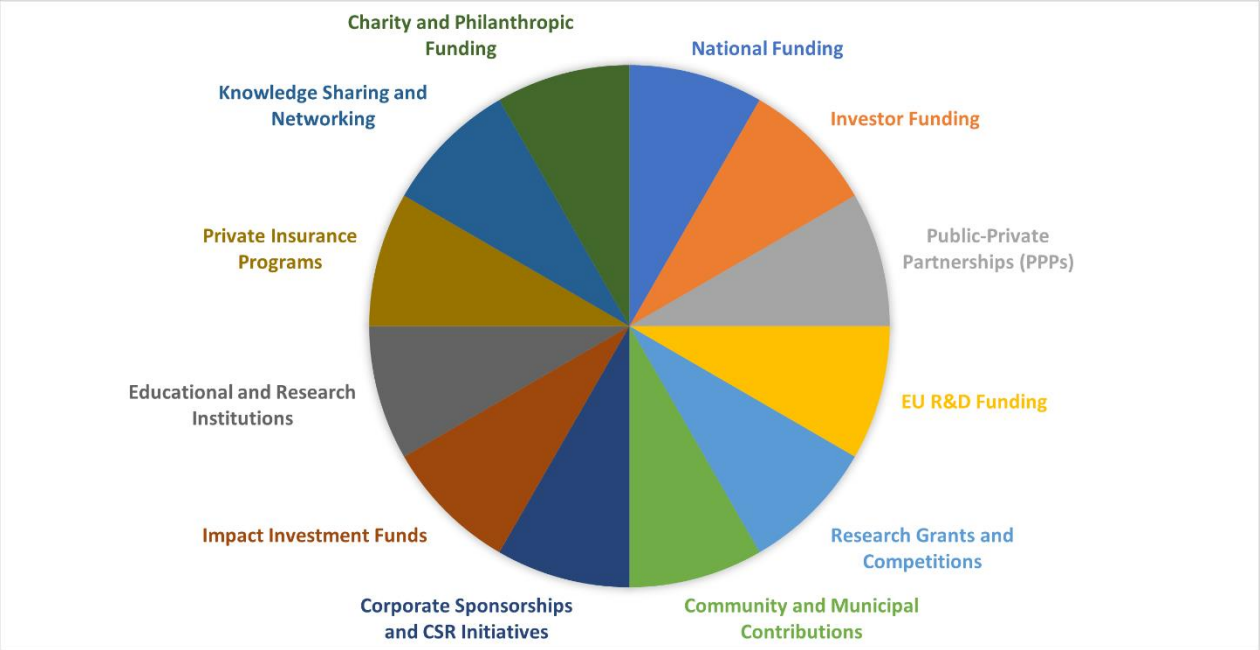

Figure 7: Funding Ecosystem pillars

Here is an overview of how such an ecosystem could be structured in twelve pillars and what is each pillar's signification:

I. **National funding:** National governments will play a crucial role in providing core funding for SHAFE projects. This funding commitment ensures stability and reliability for initiatives. Government contributions can support infrastructure, policy development, and research activities.

II. **Investor funding:** Encouraging private investors, venture capital firms, and private equity groups to invest in SHAFE is vital for financial sustainability. Governments can offer incentives such as tax breaks or grants for investments in projects that align with SHAFE goals. This approach stimulates innovation and promotes economic growth.

III. **Public-Private Partnerships (PPPs):** Establishing PPPs is a powerful mechanism for integrating private sector expertise and resources. Governments can develop frameworks and incentives to facilitate collaborations between public and private entities. PPPs can leverage both public funding and private investment to drive innovation and efficiency.

IV. **EU R&D funding:** European Union funding can be a significant source of support for SHAFE initiatives. Governments should continue to seek R&D funding from the EU, which can provide substantial resources for research, development, and implementation of innovative solutions.

V. **Research grants and competitions:** Governments, research organisations or businesses should work together to organize and fund research grants, challenges, and competitions to incentivize innovation in SHAFE-related fields. These funding mechanisms encourage entrepreneurs, researchers, and organizations to develop novel solutions.

VI. **Community and municipal contributions:** Encouraging local governments and communities to contribute to SHAFE projects can promote ownership and engagement at the grassroots level. Community investments can include infrastructure development and public spaces designed for ageing citizens.

VII. **Corporate sponsorships and CSR initiatives:** Corporations, especially those involved in healthcare, technology, and ageing-related services, can provide financial support through sponsorships and corporate social responsibility (CSR) initiatives. Governments can create policies that encourage businesses to allocate a portion of their profits to support SHAFE projects.

VIII. **Impact investment funds:** Governments can promote the establishment of impact investment funds specifically dedicated to SHAFE. These funds attract investors interested in making a positive societal impact while generating financial returns.

IX. **Educational and research institutions:** Collaboration with educational and research institutions can bring in expertise and funding for SHAFE projects. Governments can allocate resources to support academic research, which can lead to innovative solutions.

X. **Private insurance programs:** Governments can partner with private insurance companies to develop insurance products that incentivize healthy ageing and provide financial support for ageing individuals seeking SHAFE services.

XI. **Knowledge sharing and networking:** Creating platforms for knowledge sharing, networking, and collaboration among various stakeholders is essential for coordinating efforts and maximizing the impact of diverse funding sources.

XII. **Charity and philanthropic funding:** Charitable foundations, nonprofit organizations, and philanthropists often have a strong interest in promoting health and well-being for ageing populations. Governments should facilitate partnerships with these entities, providing incentives and tax deductions to encourage their contributions to SHAFE projects.

In conclusion, an ecosystem of sustainable funding strategies for SHAFE involves a multi-pronged approach, where governments serve as orchestrators, integrating various funding sources to create a comprehensive framework. This collaborative effort aims to ensure the long-term viability and success of initiatives that enhance the well-being of ageing populations, reducing the dependence on any single source of funding.

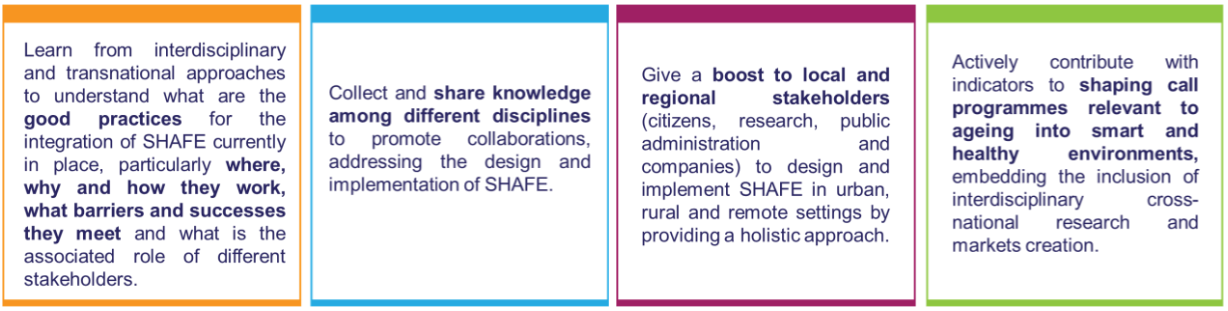

Figure 8: Action objectives

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ChatGPT, as an AI tool, was used to improve the recommendation framework based on identified stakeholders, which is further developed, and to identify additional well-being challenges, besides socio-economic previously identified.

ANNEX 1. – Domains of social, economic and environmental impact

Domains of social impact	Possible impacts for consideration
Health & longevity 	Does the solution 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 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 solution 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 solution 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 solution 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)

Domains of economic impact	Possible impacts for consideration
Standards of living 	Does the 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 solution 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

Domains of environmental impact	Possible impacts for consideration
The natural environment 	How does the solution 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 solution 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 solution 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

ANNEX 2. - Evaluation Tools for assessing innovative projects on their way to market

The below questionnaires are developed by the Group of experts called, the A7 expert group. It comprises national and international experts with experience in innovation and technology transfer, investment, entrepreneurship, legislation and research (UEFISCDI, 2021).

The A7 Group was formed during 2022, during a pilot program in order to substantiate a financing program for the development of a mechanism to support the exploitation and capitalization of the results of research, development and innovation projects and their applicability in industry and economy. In this pilot project, research directors received support to bring research project results closer to market and create social impact. For this purpose, meetings were held with directors of research projects, but also with people who sought to start businesses based on research, innovation or patent. A7 Group experts offered personalized consultancy to each project, intervening with advice and expertise in topics such as: internationalization, patenting, protection of intellectual property rights, marketing, financing.

Pre-evaluation

Implemented aspects:

1. Brief summary of the proposed project
2. Five keywords related to the proposed project
3. Maturity of the project (expressed in TRLx; short justification of the level achieved)
4. What is the application of the implementation results?
5. What is the availability of funding for implementation into a commercial product?
6. Is there a domestic/overseas patent application? If so, please provide the number
7. Is there an application for aid for the registration of the description of patent applications?
8. What is your experience in the description/registration of patent applications?
9. Are there human resources (implementation team/specialists) to reach the TRL7 level? or: what level of TRLx can be achieved with the resources currently available?
10. What is the most difficult area to achieve and the most hurdles to production/marketing?
    a. IP (patents, trademarks, copyrights, etc.)
    b. traversing TRL1-TRL4; TRL4-TRL7;

Short – version questionnaire

Project information

What are the results achieved (for the project with the highest TRL)? What is the applicability of research results? What is the maturity of the project? (expressed in TRLx; brief justification of the level achieved)

Exit planning

Which of the options for commercializing the invention and related IP rights are of interest to the owner/project team?

- Creating a spin-off/spin-out and capitalizing it for commercialization
- Setting up a joint venture with suitable partners for commercialization
- IP licensing to third parties
- Selling PI
- Other option – description

What type of collaboration did the holder of the invention think of, for the post-IP rights protection phase, namely:

1. identification of financing possibilities,
2. manufacturing agreement,
3. license agreement,
4. trade agreement with technical assistance.
5. Identifying resources and support

What type of collaboration did the holder of the invention think of, for the post-IP rights protection phase, namely:

1. identification of financial resources,
2. manufacturing agreement,
3. license agreement,
4. trade agreement with technical assistance
5. other_____

Consider that you need support:

a) in the field of IP: elaboration of patent applications + registration with OSIM for national/international protection;

b) in the RDI field: help in the management of RDI activities (definition of activities, allocation of human resources, material, etc.) to reach a TRL7 level

c) in the field of marketing in order to identify interested parties to finance a spin-off (spin-out) / to set up a joint venture / to license IP / to buy IP

Long version Questionnaire

Project Information

Please provide us with a summary of the project with the highest TRL rating (include purpose and objectives) _____

Please indicate 3-5 keywords relevant to the proposed project _____

What are the expected results? _____

Market

Why is the invention in the project advantageous compared to the solutions currently applied in that field? Argue. _____

What is the applicability of implementation results? In what products or services do you think the research results of the project can be incorporated? (We are interested in the degree of applicability) _____

Give an example of some firms or entities that, in your opinion. would be interested in implementing the invention. _____

Project maturity _____

What are the results obtained? What is the maturity of the project? (expressed in TRLx; brief justification of the level achieved) _____

What TRLx level can be reached with the resources currently available? _____

If it is lower than TRL7, are there any human resources (implementation team/specialists) to reach a TRL7 level? _____

What other resources are needed to get a TRL7? _____

What is the next step to move to a higher maturity level? _____

Do you have an estimate of the financing needs for the development of the project up to TRL 7 in order to obtain a product that can be marketed? Are there sources of funding (including own - that are available to

the owner of the invention) to co-finance the patenting process and go through TRL1-TRL7? What are they and how much would be available? _____

Exit planning

Which of the options for commercializing the invention and related IP rights are of interest to the owner/project team?

1. Creating a spin-off/spin-out and capitalizing it for commercialization
2. Setting up a joint venture with suitable partners for commercialization
3. IP licensing to third parties
4. Selling PI
5. Other option – description

What type of collaboration did the holder of the invention think of, for the post-IP rights protection phase, namely:

a) identification of financing possibilities,
b) manufacturing agreement,
c) license agreement,
d) trade agreement with technical assistance.
e) other _____

Do you have other similar products and if so, at what maturity level? _____

Is there a similar product at national/European/international level and which company/companies produce/distribute that product?

(We are interested in the products on the market, competition and potential collaborators and whether it is appropriate to enter one of the markets) _____

Which of the following steps do you consider raising the most impediments to the production/marketing process?

a) obtaining protection for intellectual property "IP" (patents, trademarks, copyrights, etc.)
b) going through TRL1-TRL4; TRL4-TRL7;

Freedom to go out on the market

What intellectual property rights "IP" exist and to whom do they belong? How are IP rights protected? Has a *Freedom to Operate* analysis been done? Is there a nationally/internationally registered patent application(s)?

- If yes, the number will be specified.
- If not, is help requested for the preparation/registration of patent applications?
- What is your experience in drafting/registering patent applications?
- Identifying resources and support

In conclusion, consider that you need support to:

a) in the field of IP: elaboration of patent applications + registration with OSIM for national/international protection; Utility model
b) in the RDI field: help in the management of RDI activities (definition of activities, allocation of human resources, material, etc.) to reach a TRL7 level
c) in the field of marketing

What type of collaboration did the holder of the invention think of, for the post-IPR protection phase, namely:

a) identification of financial resources,
b) manufacturing agreement,
c) license agreement,
d) trade agreement with technical assistance.
e) Other_____

In conclusion, do you consider that you need support to:

a) in the field of IP: elaboration of patent applications + registration with OSIM for national/international protection;
b) in the RDI field: help in the management of RDI activities (definition of activities, allocation of human resources, material, etc.) to reach a TRL7 level
c) in the field of marketing in order to identify interested parties to finance a spin-off (spin-out) / to establish a joint venture / to license IP / to buy IP

ANNEX 3. - Examples of Urban design and planning approaches

Example A1. NBS Adaptation Pathway to cope with surface flooding in Manchester.

The nature of urban morphology presents its own challenges. In addition to the spatial constraints presented by the compact design of European cities, the complexity of the existing grey infrastructure (much of it underground) means that some solutions require a green or blue footprint which is unavailable. As a result, interventions will often need to be considered which successfully integrate both green and grey infrastructure. The use of a complementary approach has been identified by scholars as a pragmatic and effective means of accounting for morphological constraints whilst at the same time promoting urban sustainability. Within the GrowGreen Project, Manchester city is co-creating an NBS Adaptation Pathway, exploring and combining different solutions to deal with surface flooding, and generating spatial data, which will over time inform planning decisions and investment opportunities. The NBS adaptation pathway approach helps to work towards a common strategic vision and clear objectives, overcoming political logic and administrative silo thinking while responding to social demand. This required substantial government commitment. https://growgreenproject.eu/

Example A2. Co-design methodologies for the conception and delivery of Urban Forests- Based Solutions in Europe and China.

The importance of the co-design approach is increasingly recognised in the planning of NBS in dense urban areas, where conflicting interests and limited space availability complicate urban development projects. Indeed, beyond agreeing on the importance of setting up participatory processes for policymaking, the CLEARING HOUSE H2020 project applies a co-design and co-learning methodology to the development of tools and guidelines that will aid in the design, governance, and management of urban forests in its 10 case studies of cities and urban regions in Europe and China. Through these case studies, the project partners will stress the need to promote the participation and collaboration of a variety of local actors from all sectors of society. This approach, commonly referred to as the Quintuple Helix approach in the literature, allows for the pooling of resources and knowledge of local actors to co-design urban services and infrastructures.

The co-design approach allows urban planners and city representatives to design NBS that integrate the needs of users and the environmental priorities of local ecosystems while leveraging the financial resources and knowledge of local stakeholders. In this way, co-design initiatives are successful in mainstreaming NBS into urban planning processes. https://clearinghouseproject.eu/

Example A3. Multi-scale perspective: from regional and local planning schemes in the city of Valencia.

With the slogan "Climate proofing urban planning through NBS," the City of Valencia is delivering an NBS Strategy in the context of the H2020 Grow Green project. The NBS Strategy builds on existing very valuable information generated at the regional and city level in relation to climate change hazards, vulnerability, and green infrastructure, as well as strategies and planning instruments that reflect the efforts of the city council to move towards adaptation. The NBS strategy focuses on identifying NBS as adaptation measures to cope with the key climate hazards faced by the city and embedded the criteria and guidelines for urbanisation incorporating NBS into the current Local Master Plan. The strategy also explores the business and financial models supporting the deployment of such NBS.

Example A4. Evidence-based planning decisions and benchmarking alternative planning scenarios: Sustainable Pocket Forest in Valencia.

Benchmarking alternative planning scenarios is conceived as a best practice. Scenarios are an effective way to deal with the uncertainty inherent to complex systems and a lack of data. Co-designed NBS interventions in the Benicalap district in Valencia has been benchmarked using modelling exercise to comparatively assess their effectiveness against thermal comfort and co-benefits, and to decide which ones have less significant impacts and maximise the green infrastructure network and provision of ecosystem services in the city. A co-creation approach involving a whole range of stakeholders, from institutional decision-makers to local residents was applied. https://growgreenproject.eu/implementing-nature-based-solutions-valencia/

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