

**Call for tender for the presentation of proposals for the Strengthening of research structures and creation of R&D "*innovation ecosystems*", set up of "*territorial leaders in R&D*" — to be funded under the National Recovery and Resilience Plan (NRRP), Mission 4, Component 2 Investment 1.4, funded from the European Union - NextGenerationEU.**

**Annex 1 - Project proposal**  
**(Article 10, paragraph 3 and Article 12 of the Call)**

**NAME OF THE INNOVATION ECOSYSTEM:** RAISE (Robotics and AI for Socio-economic Empowerment)

**DURATION OF THE RESEARCH AND INNOVATION PROGRAM (months):** 36

**NAME OF THE PROPOSER:** UNIVERSITA' DEGLI STUDI DI GENOVA

**IMPLEMENTING BODY - HUB:**

Names of the parties involved: Università degli Studi di Genova (UniGe), Consiglio Nazionale delle Ricerche (CNR), Istituto Italiano di Tecnologia (IIT), Regione Liguria, F.I.L.S.E. S.p.A. (FILSE), Liguria Digitale S.p.A. (Liguria Digitale), ANCI Liguria, Centro Internazionale in Monitoraggio Ambientale - Fondazione CIMA (CIMA), Job Centre S.r.l. (Job Centre)

Chosen legal form: Consortium

**SPOKE AND AFFILIATE WITH THE SPOKE PERFORMING PARTIES:**

Università degli Studi di Genova (UniGe), Consiglio Nazionale delle Ricerche (CNR), Istituto Italiano di Tecnologia (IIT), IRCCS Ospedale Policlinico San Martino (HSM), E.O. Ospedale Galliera (Galliera), Istituto Giannina Gaslini (Gaslini), Istituto Nazionale di Fisica Nucleare (INFN), Aitek S.p.A. (Aitek), Centro Internazionale in Monitoraggio Ambientale - Fondazione CIMA (CIMA), ETT S.p.A. (ETT), Fondazione Italiana Sclerosi Multipla Onlus (FISM), Esaote S.p.A. (Esaote), Philips S.p.A. (Philips), Associazione Festival della Scienza (AFS), Ansaldo Energia S.p.A. (Ansaldo Energia), Leonardo S.p.A. (Leonardo), Engineering Ingegneria Informatica S.p.A. (EII), Circle S.p.A. (Circle), algoWatt S.p.A. (algoWatt), Fondazione Don Carlo Gnocchi Onlus (FDG), Istituto Nazionale di Geofisica e Vulcanologia (INGV), Fincantieri S.p.A. (Fincantieri), Movendo Technology S.r.l. (Movendo Technology), Enea - Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile (ENEA), Info Solution S.r.l. (Info Solution)

*The synthetic versions of the names of the various entities that will be used within the document for reasons of brevity are indicated in brackets*

**COST OF THE PROGRAM:** € 144.442.024,00

**NRRP THEMATIC AREA:**

- Digital, Industry, Aerospace
- Climate, Energy, Sustainable Mobility
- Health

**TERRITORY OF REFERENCE:** Liguria Region

# 1 AREA OF SPECIALIZATION / SCIENTIFIC AND TECHNOLOGICAL FOCUS

## 1.1 Specialization area of RAISE and scientific and economic vocations of the territory of reference

The ROBOTICS AND AI FOR SOCIO-ECONOMIC EMPOWERMENT (RAISE) project aims to sustain the development of an innovation ecosystem based on the scientific and technological domains of AI and Robotics, focusing on the needs of a specific regional context, i.e., the Liguria Region. It eventually aspires to evolving into an ecosystem highly attractive for firms, investors and researchers, both at national and international level.

The proposed project is rooted in a regional territory characterized by scientific, technological, and economic specificities. In this perspective, it aims to build on strengths and help reduce weaknesses, by leveraging on existing resources and capabilities as well as by generating new opportunities through effective and efficient knowledge transfer. The idea underlying this ecosystem is to coordinate and value these projects in a logic of integrating technology transfer system, using the local market as an extraordinary and immediate testing lab. In this perspective, the ecosystem represents a sort of “engine” to rewrite the basis of Italian industrialization not only addressing the “Digital Transformation” but also going towards a further evolution in which the looming “lack of hands” will be solved through a “Robotic Transformation” that requires strategic and technological support to be reached. In this sense, research, business, and financial system need to rethink the way they develop in Italy, to tackle the energy challenge and, in line with RRI approach promoted by EC, to include a solid ethical and human-centred design, by creating stable and virtuous connections among the actors involved and enacting an environment that favours innovation with high economic and social impact. Finally, it proposes the ambitious objective of assuming a reference role in the outlined specialization area, at national and international level.

The territorial context at stake has noteworthy features that are recalled below, focusing first on the elements connecting the specialization of RAISE with the scientific and economic vocations of the Liguria Region, and then highlighting the elements of synergy between the proposed program and research and innovation priorities, as defined by the Smart Specialization Strategy of the Liguria Region.

While Liguria presents, overall, some weaknesses in its capacity to innovate (cf. § 1.2), it does present some excellences rooted in the local territory that are precisely active in the specialization sectors identified by RAISE. Among the various competences present in the ecosystem, one can, for instance, highlight those of the IIT, which is headquartered in Genoa and whose research focus (robotics, nanomaterials, technologies for life science, and computational science) is closely convergent with RAISE area of specialization. Mention should be made of the distinctive role of the CNR whose multidisciplinary mission and nation-wide organization brings into the ecosystem a great networking potential and specific competences not only in science and innovation (ICT, IoT and sensor design, environmental protection, automation) but also in social and economic fields. Also, with regard to affiliated companies, leading companies in the area of specialization are involved. For example, Leonardo s.p.a who has in Genoa is primary site for Cyber Security and that already has consolidated partnerships with Hub members, such as the Leonardo - IIT joint lab on robotics and AI.

More generally, the, the research institutions and companies involved in the ecosystem guarantee (as further illustrated in Section 2 of the proposal) a top-level scientific and technological excellence, as demonstrated by the number of scientific papers, patents, start-ups and spin-offs, international relations, exports, as well as the presence of a prominent quantity of R&D workers in companies.

Liguria, due to its morphological, social, and economic characteristics, has always anticipated the dynamics that would later be found throughout the nation. Therefore, it represents a sort of laboratory to test the validity of new tools and policies for a territorial development capable not only of making the ecological and digital transition effective, but at the same time increasing the resilience of the region itself. Liguria is a fragile territory, with a strong anthropic pressure on a narrow coastal strip closed behind by a mountain range that has long suffered the consequences of the abandonment of production activities and depopulation.

The presence of three of the most important national seaports makes the industries that form the blue economy preponderant in the regional economic structure. The industrial activity over time has contracted in size and specialized in knowledge-intensive activities, such as robotics, biomedical and ICT. An industrial sector mainly consisting of SMEs, a low birth rate and the high average age of the population make the region comparatively scarcely permeable to innovations, despite the presence of intense activity of basic and applied scientific research and interesting patent

production, spread throughout the region. Over time, there has been a convergence between the region's manufacturing specializations and the scientific vocations of the population, as evidenced, for instance, by the high rate of registered patents and the share of STEM researchers on the regional population.

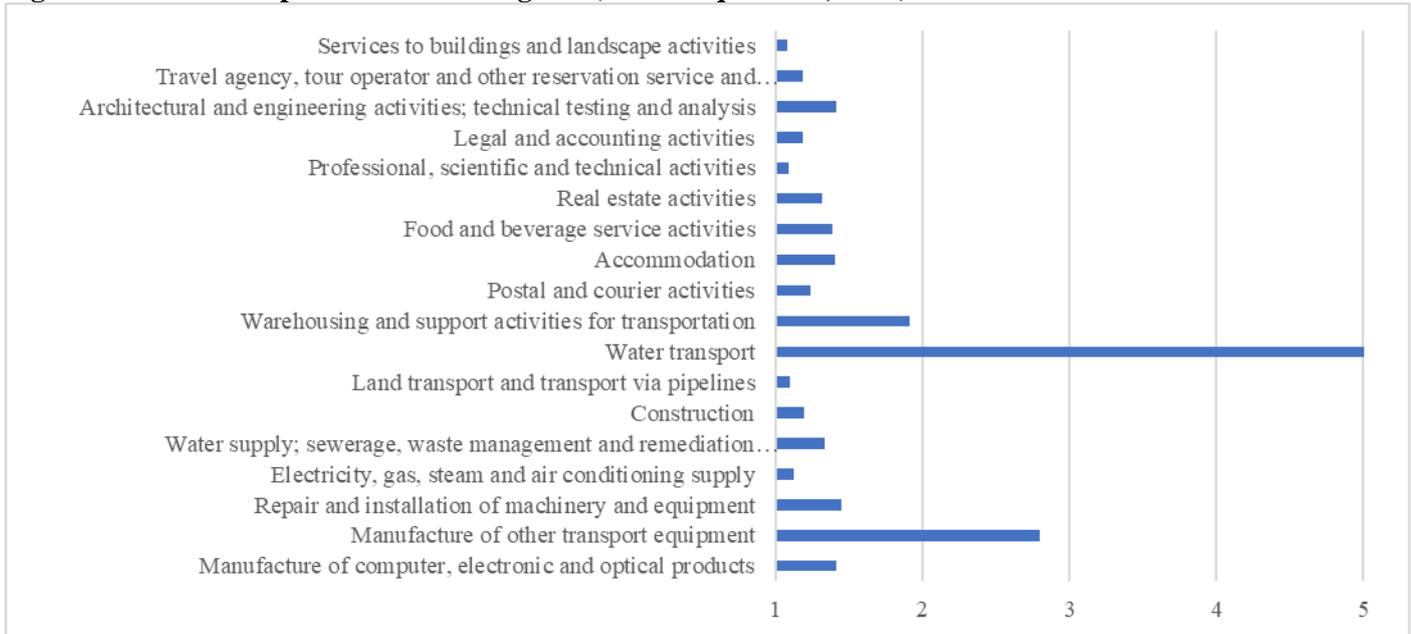
**Table 1 – Peculiarities of Liguria compared to Italy**

Domain	Index	Liguria	Italy
<b>Social</b>	Birth rate (2020)	5.8	6.8
	Average age of population (2020)	49.2	45.9
	Graduated Population (6+ years)	9.54	8.65
<b>Economic</b>	Share of tertiary sector on total employment (% , 2020)	77.9	69.5
	Average number of workers per firm (2020)	3.48	3.59
	% Employment in technology and knowledge-intensive sectors (2008)	4.9	4.4
<b>Scientific</b>	High-tech patent applications per million inhabitants (2012)	15.3	4.9
	% Scientists and engineers on population	2.45	1.95
	% R&D personnel and researchers on total employment (2019)	1.30	1.40
<b>Healthcare</b>	Hospital days of in-patients per inhabitant (2019)	1.06	0.90
	In-patient average length of stay (days, 2019)	8.4	8.0
	Deaths per 100,000 inhabitants (2018)	1,416	1,042

Source: Istat and Eurostat websites

The RAISE spokes are defined as connecting elements between the needs of the territory and its economic vocation (see fig. 1) on the one hand, and high-potential applications of the areas of specialization (robotic technologies, Machine Learning, Artificial Intelligence and smart sensors) on the other hand. While the project looks toward digital and ecological transition, RAISE considers the centrality of the individual as an element that connects all the choices that underlie the ecosystem. More specifically, Spoke 1. “Urban Technologies for Inclusive Engagement” emphasizes the search for solutions for a better livability of the urban environment, in a contest characterized by multiple categories of populations with specific needs. Spoke 2. “Smart Devices and Technologies for Personal and Remote Healthcare”, on the other hand, assumes a strategic value in responding to the needs of the ageing population. Spoke 3. “Environmental Caring & Protection Technologies, and Towards a Zero Emission Environment” responds to the need to address some of the main fragilities of the Ligurian territory, such as hydrogeological and seismic risk and the quality of marine environment. Furthermore, this spoke (as well as Spoke 4) aims at contributing to energy transition through a more efficient use of energy and the development of renewable sources. Spoke 4 “Smart and Sustainable Ports” is dedicated to strengthening the economic engine of the Liguria region, i.e., its port systems. This spoke has a strong focus on issues of safety and security, as well as environmental sustainability, both with reference to global climate objectives and to the reduction of their negative environmental impacts on local communities and environment. Finally, Spoke 5. “An engine for Knowledge and Technology Transfer” represents a transversal objective aimed at maximizing the possible outcomes of scientific research and making the processes developed within RAISE long-lasting and self-reinforcing.

Figure 1 - Industrial specializations of Liguria (location quotients, 2018)



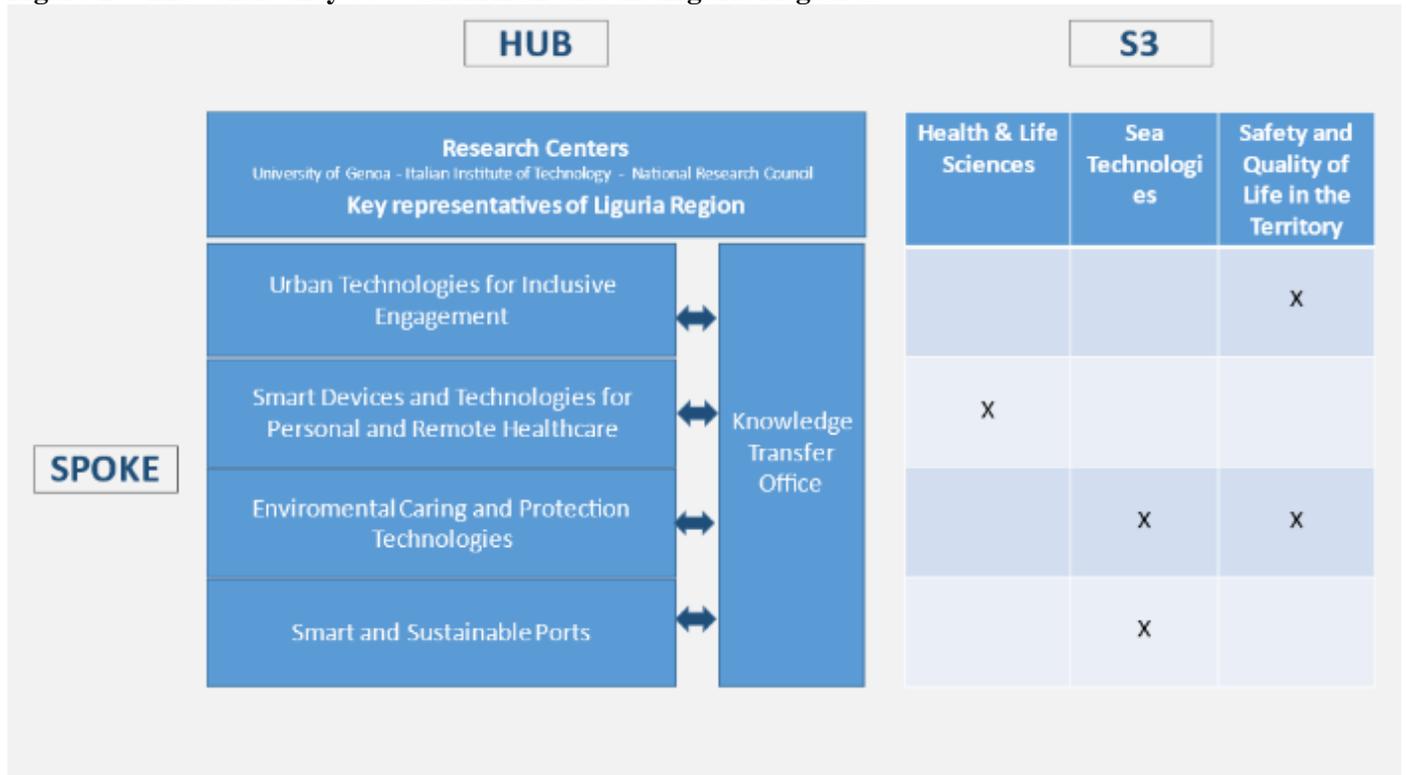
Source: Eurostat website

## 1.2 Consistency between the research and innovation program with regional operational plans and research and innovation priorities

The proposed ecosystem enhances and develops regional vocations and is fully consistent with the regional research, development, and innovation programme, combining the skills expressed by the region with its main economic, social, and cultural needs. In this vein, it is worth mentioning the Smart Specialisation Strategy of the Liguria Region, which identifies three macro sectors of specialisation considered fundamental to guarantee inclusive and sustainable growth: sea technologies, safety and quality of life in the territory, health and life sciences. In all three sectors, the importance of research and development in the field of robotic technologies and artificial intelligence is highly stressed.

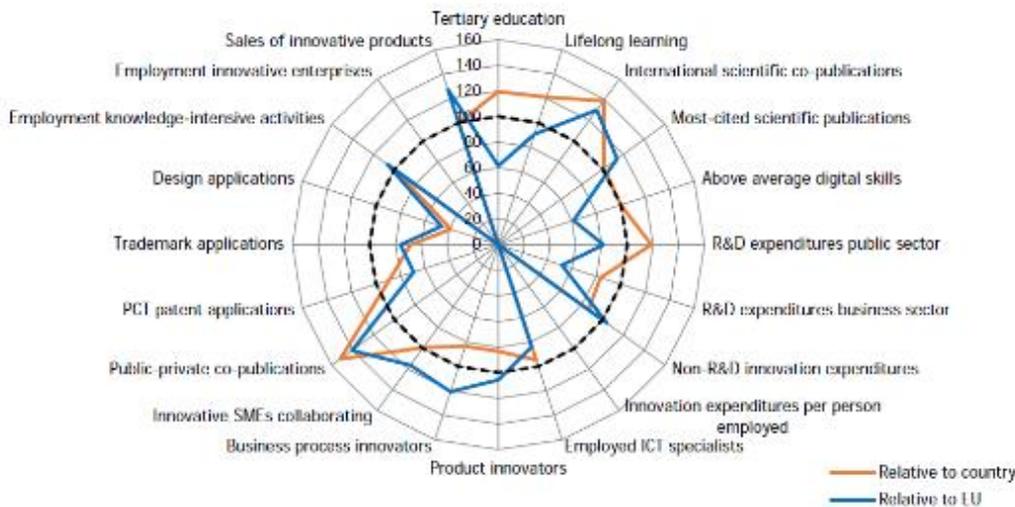
RAISE, starting from a specific scientific and technological focus that positions Liguria at a high international level, intercepts the development trajectories identified in S3, which the context analysis has highlighted as being more responsive to the needs of growth, sustainability, and inclusion. Within the specialisation area "**Technologies of the Sea**", the following S3 priority themes have been considered: Logistics, safety and automation in port areas and protection and enhancement of the marine coastal environment. Regarding the specialisation area "**Security and quality of life in the territory**", the S3 priority themes included in the RAISE proposal are Smart Environment and Security and Territorial Monitoring. The priority themes in the specialisation area "**Health and Life Sciences**" are Diagnostic Platforms, Technologies for Rehabilitation, Care, Integration and Education.

Figure 2 – The consistency between RAISE and the Liguria Region S3



The themes and priorities identified by the Liguria Region in the Smart Specialization Strategy are confirmed in the “Liguria Region 2021-2027 Programming Document” whose strategy is the improvement of the competitiveness and attractiveness of the territory, concerning both productive activities and quality of life, by promoting the long-term transition towards a sustainable, inclusive, and dynamic development model. The priority is to develop and strengthen the competitiveness of the Ligurian system by focusing on innovation, research, advanced technologies, digitalization and investment strategies. This priority objective arises from the need to bridge certain structural gaps in the Ligurian economic system. Indeed, in the national and European context, the Liguria region is placed in the cluster of Moderate Innovators (C3), i.e. in the penultimate place within a scale ranging from Innovation Leaders to Emerging Innovators, with a trend of improving its position (+28.2 percentage points compared to the EU base index 2014). Thanks to this improvement it has achieved a level above the EU average, which allowed it to move from the 152<sup>nd</sup> position in 2014 to 136<sup>th</sup> in 2020 (Regional Innovation Scoreboard, 2021). Despite this improvement, the Liguria Region still shows some weaknesses, especially when compared to the EU average (see the figure below, which highlights relative strengths compared to Italy and the EU with the orange and blue lines respectively). More specifically, the low level of “Innovation expenditures per person employed” and “Employment innovative enterprises” witnesses the need for firms’ stronger commitment toward innovation (firm investment) and the poor contribution of innovative enterprises to employment (impact). In this vein, RAISE may contribute to improving the innovative performances of the regional economy, thanks to stronger relationships between the different actors operating in the scientific and technological domains of the project as well as to effective knowledge transfer mechanisms.

Figure 3 - Relative strengths and weaknesses compared to Italy and EU



In this perspective, in line with the broader regional development strategy and continuity with previous programs, the project intends to promote innovation within companies, with specific attention to the territorial rooting of their specializations and those identified in the Intelligent Specialization Strategy. In line with the experience of Innovation Poles and Technological Districts, there is a profound awareness of the importance of networking activities, especially between firms and public research centres. Therefore, it is a priority of the Regional Program to support existing forms of cooperation and promote new forms of aggregation between companies and other innovation players, regarding the most dynamic and relevant productive sectors for the territory. The RAISE Ecosystem is therefore intended to respond to specific needs of the territory, by leveraging on existing resources and creating new opportunities for innovation and competitiveness.

In addition, beyond the synergies of RAISE with regional planning and projects, it is also worth mentioning how it can contribute to the achievement of European strategic goals. Besides the contribution of several spoke to Zero Emissions goals, the development of cloud and edge computing is part of different RAISE measures. This sector is one of the six strategic sectors identified by Eurostat and the project will therefore contribute to reducing Europe's dependence on foreign countries in this field, through the development of specific capacities and skills.

### 1.3 Consistency with existing initiatives

The Smart Specialisation Strategy of the Liguria Region defines, in addition to the thematic priorities, the framework of initiatives and instruments supporting the research and innovation system of the territory. The Innovation Poles, identified as intermediate governance tools, are defined as groupings of independent enterprises, innovative start-ups, small, medium and large enterprises, as well as research organisations, active in a particular sector or territorial area and intended to stimulate innovative activity by encouraging intensive interaction, the joint use of facilities and the exchange of knowledge and experience. The Ligurian Research and Innovation Poles are: (i) Polo PLSV (Life Sciences); (ii) Polo SOSIA (Security and Automation); (iii) Polo TRANSIT (Logistics and Transport); (iv) Polo DLTM (Sea and Marine Technologies); (v) Polo EASS (Innovation Energy, Environment and Sustainable Development).

Right from the early stages of planning of the RAISE proposal, the research organisations involved launched a process of comparison with the regional actors to enhance the experiences and initiatives in the area, avoiding any possible duplication. An initial concept proposal was presented to the regional forum of stakeholders involved in the planning and implementation of research and innovation policies, to share the proposed technological focus and application fields. Moreover, a one-day workshop was organised in which all stakeholders worked in parallel sessions to develop an initial hypothesis of activity lines for each Spoke, bearing in mind the complementarity and enhancement of existing initiatives. After the start of the activities, the presence of Regione Liguria in the Hub and of an Advisory Board in the Hub composed of regional stakeholders (such as the Innovation Research Poles, START4.0, Digital Innovation Hub Liguria) will continue to guarantee complementarity with existing initiatives. The Advisory Board can be integrated with the representatives of new relevant initiatives (e.g. European Digital Innovation Hub).

In conclusion, Liguria is an open-air laboratory where demographic trends have shown up earlier than anywhere in the world and presents some of the largest Italian research laboratories on robotics and AI, with scientific

programs that explore the co-presence of intelligent machines alongside humans to improve the quality of life and work. RAISE aims precisely to coordinate and value all robotics and AI initiatives in a logic of integrating the technology transfer system, using the local market as an extraordinary and immediate testing lab. RAISE will therefore be a catalyst to redefine the basis of Italian industrialization, riding the wave of digital transformation and addressing the looming "lack of hands" issue thanks to robotic transformation, also tackling the energy challenge and always maintaining an ethical and human-centred design.

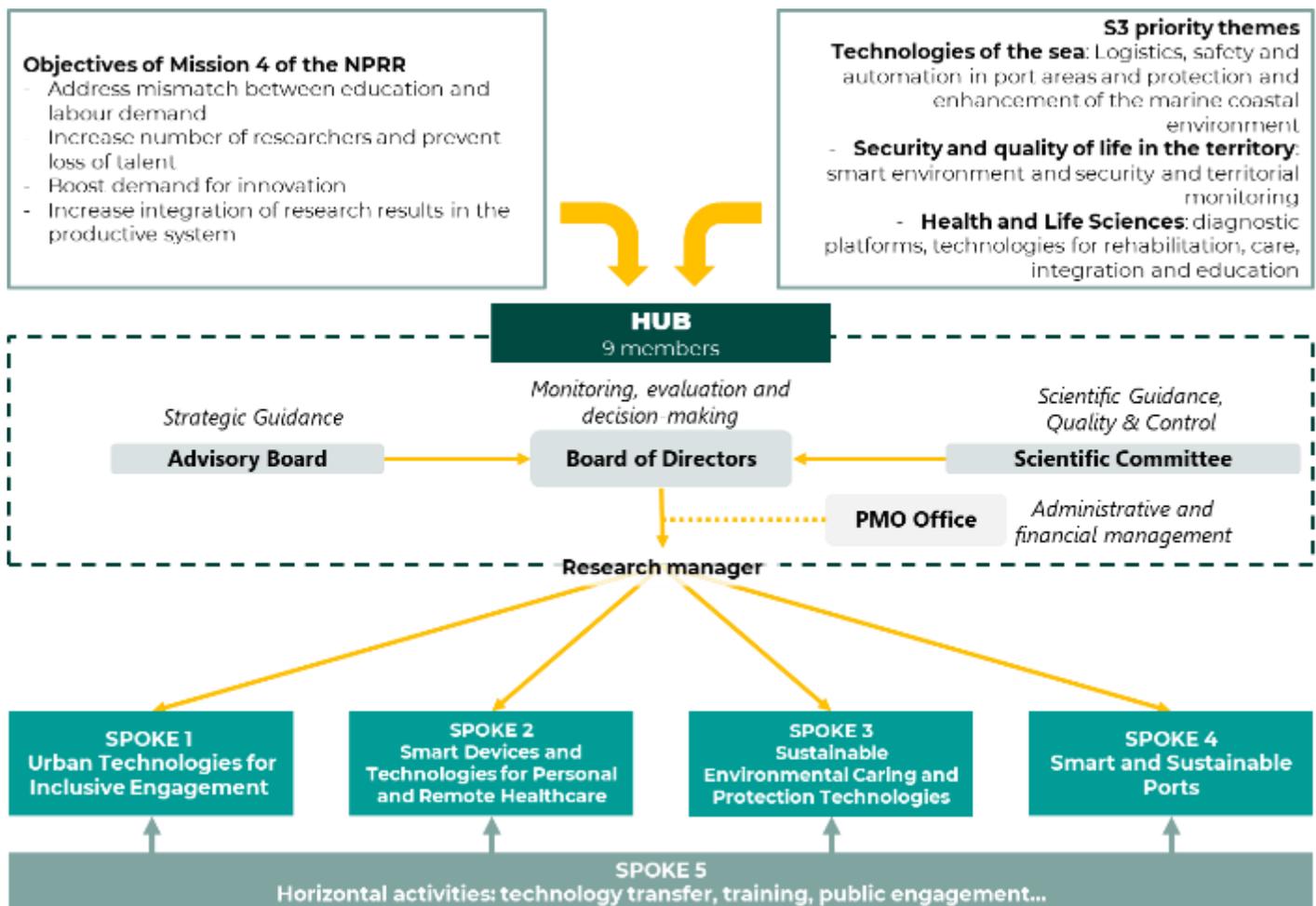
In short, RAISE integrates the best competencies in the fields of Robotics and Artificial Intelligence present in the Ligurian territory, placing them in well-defined research and development trajectories, on the one hand, consistent with the regional S3, and on the other hand not overlapping with the activities already underway in the territory. To guarantee the complementarity of the initiatives and the absence of duplication, the Liguria Region has chosen to participate in the HUB, with programming and liaison functions with the Ministries on research and innovation issues.

## 2 OBJECTIVES AND SCIENTIFIC QUALITY

### 2.1 Specific activities planned, methodology for the implementation of the research and innovation programme, characteristics, objectives, relevance at the root of the research and innovation program

#### 2.1.1 Overview of the research and innovation programme

Within the context presented in Section 1, the activities of RAISE are articulated in thematic applications focused on domains and themes that build upon scientific and industrial vocations of a specific area while addressing specific economic and social innovation needs. The organisational structure of the ecosystem was designed to build upon these premises, as shown in the following figure.



The synergic and cross-sectoral policy carried out by the ecosystem has been declined with the aim of resolving some of the criticalities that the PNRR intends to overcome to create the conditions "for the development of a knowledge-intensive, competitive and resilient economy", with particular reference to about the mismatch between education and labour demand, to the low number of researchers and loss of talent and to the reduced demand for innovation, and to the limited integration of research results in the productive system.

Based on and consistent with the above-mentioned objectives, RAISE is located and rooted in the Ligurian region, where it finds its motivations (as described in the context analysis in Section 1) in terms of: choice of technological focus, application verticals and actions to be undertaken.

The objective of RAISE is focused on the satisfaction of the demand for innovation, the strengthening of collaborations and the contamination between research and enterprise, the attraction of young people, the response to the main needs/critical issues of the territory (from remote assistance, to land protection, to sustainable development of ports, to the quality of life in urban environments) and the approach of the general public to the understanding and deepening of

research and technology issues and issues of considerable social and economic impact, enhancing the multidisciplinary approach.

The specific alliance (components of the HUB, SPOKES and affiliates of the SPOKES described in the following section) responds to the need to achieve the objectives outlined above, creating a balance between research organizations, businesses, local authorities capable of addressing and expressing needs, IRCCSs (Scientific Institute for Research, Hospitalization and Healthcare), structures dedicated to technology transfer and to the development of social sustainability projects, institutions with deep experience in the dissemination of scientific culture and public engagement.

Within this framework, the RAISE ecosystem has defined specific lines of activity (Raise Connect) with the aim of creating strong synergies with companies and research organisations located in southern Italy.

Specifically, Raise Connect is the initiative of the Liguria ecosystem to provide effective collaboration for the development of southern Italy and to build a technological and scientific supply chain bridge, and acts with four different transfer systems:

- 1) funding with cascading calls for companies that can validly provide engineering and industrial development services to the ecosystem's activities
- 2) funding with cascading calls for entrepreneurial initiatives and start-ups within the ecosystem's technological focus themes
- 3) funding for integration with technological projects already present in the south of Italy
- 4) funding for research teams from universities present in the south of Italy to contribute to RAISE research

The aim is to transfer skills, technical capabilities and build industrial, research and supply connections for the sustainability of RAISE's long-term impact

The ecosystem bases its action on specific activities, clearly defined in terms of results and responsibilities, measurable *in itinere* and *ex post* (as extensively described in the Impact Section) and coordinated and directed as a whole by the HUB to ensure full adherence to the macro-objectives of the ecosystem itself.

These activities can be briefly defined as follows:

- **Research and innovation programme** carried out by research organizations and enterprises (SPOKE and SPOKE affiliates) in the field of Robotics and Artificial Intelligence with impact in the areas defined in each SPOKE (see Section C for details: workplan, costs, time schedule) in order to foster the sharing of skills, infrastructures and methodologies and to support their full integration and contamination. The institutions involved (local authorities, associations, hospitals) have the specific task of orienting this research towards social needs, guaranteeing the full participation of civil society, developing actions and approaches based on the co-design of ideas and solutions (quadruple helix model). For this reason, the four thematic SPOKES transfer the research focus (Robotics and AI) into innovative, sustainable, inclusive solutions for industry, society and the environment by defining specific application domains and intervention perimeters. In relation to the implementation methods, each SPOKE will have specific internal management and control functions (dedicated work package) and a formally constituted steering committee whose coordinator will operate in close contact with the HUB and its Advisory Board. The components of the RAISE ecosystem (research organizations and enterprises involved in the SPOKES) guarantee the pooling of the best competences in the area, with a prominent position on the international panorama and capable of creating a system of collaboration with highly qualified scientific institutions.
- **Acceleration, de-risking and proof-of-concept grant programmes** are dedicated mainly to start-ups and small enterprises outside the ecosystem to promote technology transfer, also through the creation of a stable and integrated external knowledge transfer office in the area between all the research institutions involved, which provides services to the ecosystem even after the completion of the funded programme to contribute to its sustainability in the medium term. The activity will be concentrated and carried out within SPOKE 5, where staff specialized in IPR protection, licensing, the creation of start-ups and the development of innovative business models will operate. The programme will promote and support initiatives based on the themes of digital and green transition and will build the basis for making the area attractive for new business initiatives, also through the provision of physical locations for incubation (already available to the constituents of the HUB). This line of activity will be responsible for the impact and development objectives of the ecosystem. Given the strategic nature of this activity and the necessary attention to its effective implementation, SPOKE 5 will have, in addition to the steering committee (as for the other SPOKES), two stable networks according to an open innovation strategy. We refer in particular to:

- 1) Mentor Company Network - a network of large companies inside and outside the ecosystem that will be involved in the grant selection processes and will direct specific calls financed with their own resources for start-ups and SMEs and aimed at solving technological problems;
  - 2) Investor Network - a network of investors focused on technology transfer, proof of concept, seed and early-stage deals in spinoffs and start-ups steaming out research centres. The quality and effectiveness of these actions are guaranteed by the high level of qualification of the staff made available by the research organizations involved (in particular IIT, CNR and UniGe), which have been engaged for years at national and international level in technology transfer activities but also in call management for the assignment of specific grants for technology acceleration.
- The third category of actions to be carried out by the ecosystem concerns outreach, **communication and public engagement initiatives**, which will take the form of organizing events, exhibitions, workshops and shows, and which will be an integral part of the research and development projects conducted and financed by the ecosystem. The aim is to raise awareness among the general public, starting with children and young people, to make research results available and usable, to enter into direct interaction with society in order to support the democratization of advances in knowledge and awareness of the developments and applications of robotics and artificial intelligence while addressing the complex ethical issues related to them. Actions will be based on three main strands along the lines proposed by the European Research Council:
- Involve (citizen science): for activities conducted in collaboration or consultation with the public.
  - Inspire (public outreach): for activities highlighting a research topic, disseminating its content, promoting debate and/or inspiring potential future researchers.
  - Influence (media and policy): for activities that promote consultation and change with groups of citizens in order to raise awareness on a specific topic.

The communication aspect is strategic, which, in addition to achieving the objectives of disseminating knowledge in relation to the results of the ecosystem, will have to consolidate the identity of the ecosystem and its promotion at national and international level in order to support the attraction of new investments and talent in the Ligurian territory.

As for all the other actions, great attention has been paid to ensuring that the ecosystem's internal competencies are able to activate specific initiatives on the reference themes right from the very early stage. In addition to the specific competences of the research organizations involved (organization and implementation of events, exhibitions, laboratories), the presence of the affiliates as AFS and ETT Solutions (see description below) should be emphasized, which guarantee, on the one hand, access to nationally and internationally important initiatives located in Liguria and the design and development of communication and outreach tools of absolute importance.

- In the same direction, **the training activity** represents a fundamental pillar of the RAISE ecosystem structure and the various initiatives foreseen are intended to respond to the need to reduce the skills mismatch between education and labour demand, which is particularly relevant in the area of RAISE competence (Robotics and Artificial Intelligence) and in the Ligurian territory. For this reason, the contents of the various training initiatives will be designed and developed in close collaboration with the representatives of the local industrial world and the other members of the Advisory Board of the HUB. Also in this case the role of the Region is fundamental to integrate the resources of the European Social Fund avoiding duplications and favouring complementarities.

In order to meet the skills needs of companies (with particular reference to SMEs) in a framework that is constantly evolving in technological terms, education and training initiatives will be implemented through:

- AI&Robotics education and training programmes from 4 to 8 level of the European Qualification Framework, also in collaboration with secondary schools and ITS (Higher Technical Institutes), and working on training and updating of teachers. Postgraduates training programs, to build the most requested AI & robotics profiles, with specific curricula on 4 spokes fields and Industrial Doctorates, with a strongly multidisciplinary approach, combining technological topics of interest to the companies involved with management, IPR protection and ethics. The model for UniGe PhD that best fit the timing of PNRR and of MUR appointment for PhD cycles, is a two phases deployment of grants: I) at the first year of RAISE ecosystem (solar year 2022-2023) corresponding to the 38th cycle, grants would be associated to existing PhD courses II) from the second year of RAISE, dedicated curricula to PNRR grants, compliant with the rules of Industrial PhD appointment will be activated on-demand;

- a vocational and executive training programme for who already leads an innovative deep-tech start-up or SME or aims to in the future, providing entrepreneurial and management tools; for all private companies and institutions, to learn to identify which problems AI and robotics can help to solve and how it will continue to transform their businesses and create a competitive advantage.

The training methods used to grow this culture and these skills in our innovation ecosystem are strongly interconnected within the network relationships that take place between research bodies, businesses, and civil society, in which all the actors, including young students, learn while contributing together to make social innovation. Who involved in training-action processes is invited to participate in living and contamination labs. This model of innovation and learning, the so-called "quintuple helix", is realized in RAISE in the planned living labs, in which research moves from laboratories to real-life contexts where potential customers / users cooperate with researchers, developers and designers in the innovative process. People in training find in living labs the best field to apply and test what they have learned.

The quality and originality of the RAISE training offer will also be a tool to attract start ups and young talents from other territories. To this end, specific actions will be actuated (grants for young researchers, hospitality, etc.).

## 2.1.2 Overview of the Spokes

The present section outlines the methodology that will be implemented for the implementation of the activities of the five Spokes and their work programmes that constitute the research and innovation programme, also illustrating their key characteristics and objectives. A more detailed account of the different tasks that are included in work programme is presented in Section 3.

### 2.1.2.1 Spoke 1 – Urban technologies for inclusive engagement

Scientific and technological advances are bringing AI and robotics-enhanced cities closer to reality, shaping the vision of the future “social infrastructure” as an ecosystem of interconnected smart devices and services that serve communities and individuals interacting among themselves and with the city and its services. Smart Cities already embody the digital transformation of urban spaces: big data collected by IoT networks used to monitor the status of a city, and its services, used chiefly for governance purposes and also for participatory urban design. Is it possible to evolve the concept of Smart City further and put individuals, with their abilities, at the centre of the design process of intelligent cities of tomorrow? Can we imagine a social infrastructure built on technology that genuinely serves individuals’ needs and enhances their quality of life?

The spoke objective is to develop solutions that improve the level of engagement and quality of interaction among individuals and with the urban context, focusing on in-depth analysis of the interaction needs of abled and impaired individuals. We aim at building a Smart City infrastructure able to communicate to its citizens about well-being: the quality of the urban environment is defined by many parameters (e.g., air condition, temperature, noise, urban soundscape, crowding, illumination), each affecting the subjective well-being of the individuals interacting with and in the city. The individuals’ characteristics determine the degree of perceived well-being, which we plan to capture and model by basic sensory psychophysical, and motor measurements. The “human status” and the “city status” are then coupled to design personalized services and smart interaction devices able to react to the status of the physical context in which they are used, adapting, and modulating their behaviour based on individuals’ skills and on the conditions that may influence the experience dynamically.

According to this vision, the economic value leveraged by redesigning cities is enormous. The societal impact is even more: human-centric innovation is considered a key driver at the national and European level and calls for highly multi-disciplinary initiatives engaging all stakeholders in the co-creation process.

The main goal will be realized by focusing on the following actions:

- 1) Set up participatory co-creation spaces for the experimentation in humans and the design of technological solutions to quantify the “human status”, improve inclusion and optimal access to urban spaces and their services – Living Labs as co-design spaces to implement a design thinking approach
- 2) Set up a platform for the collection of data about the urban status, specialized in gathering and quantifying/qualifying the ability of the urban space to provide a certain level of life quality – City’s offer for the well-being of its citizens.
- 3) Study and develop methods, devices, and interfaces to facilitate interaction among individuals – Research and development of innovative interaction modalities

- 4) Design, implementation, set-up, and validation of demonstrators in the Ligurian territory – Seed nodes of the Liguria social infrastructure
- 5) Elaborate best practices to support local authorities in adopting evidence-based policymaking and to be quick in the uptake of innovative urban technologies – From co-designed innovation to design of Inclusive Smart Cities.

The improvement of inclusiveness and engagement level will be pursued at different levels:

- Overcoming accessibility barriers, working on technological solutions to compensate for sensory or cognitive inabilities or deficits, with the aim to ease access to mobility, cultural experiences, training, education, leisure, or entertainment, and improve social interactions.
- Enable decision-making for citizens and local authorities driven by well-being criteria, developing new and personalized mapping approaches to communicate with citizens about the urban status concerning livability.
- Raising awareness on the potential of AI-driven devices and services, as new urban design and planning instruments.

Regione Liguria is a perfect open-air laboratory for setting up the framework described above and for testing the innovation potential of AI-enhanced intelligent devices and services for inclusive engagement: the demographic structure of the Ligurian population (over 28% of the elderly people in the Ligurian territory), the specificity of our urban areas, and the richness of the scientific and technological offer of the region constitute a solid foundation for the work to be done. Regione Liguria has been recognized as a European reference site for Healthy and Active Aging thanks to the existing ecosystem of national, regional and local authorities, hospitals and public research bodies, as well as associations of the Third sectors and ICT-related small-medium enterprises able to turn the healthy and active aging into social and economic value.

The collective expertise of the spoke's team and the rich network of associations of the Third sector of the territory provides the necessary ground for a fast kick-off of the activities planned. The complexity underlying the ambitious goal of Spoke 1 will be tackled by focusing on selected case studies that capture different types of urban spaces (indoor/outdoor, public/private), different kinds of activities (cultural, ludic, educational), as well as generic communication among people in the urban space. While the finalization of the pilot selection is part of the Living Lab action, we provide below concrete examples that emerged during the proposal writing phase, each addressing different well-being aspects (e.g., physical, social, emotional, psychological):

- the design of inclusive outdoor play areas, thinking of play areas as a space for leisure but also for inter-generational communication and self-training for cognitive and/or sensorimotor deficit;
- the design of inclusive routes for city experiencing, considering users with and without impairment, addressing accessibility barriers, physical or intangible, as well as security;
- the design of classrooms, focusing on children or teenagers, not only as resilient physical spaces (e.g., control over micro-climate and wholesome air conditions) but also resilient communication spaces, accommodating for interactions that take place in the classroom as well as in remote modality (the recent experience of the impact of the pandemic on education calls for special attention to this context);
- the design of house rooms, focusing on elderly and/or subjects with cognitive and/or sensorimotor deficit, thinking of the house as a place to support self-sufficiency and to offer stable and engaging connections to avoid the sense of isolation.

The work to be done at the technological level will run side-by-side with activities addressing the public administration side of urban planning, with two main objectives: the development of evidence-based decision-making approaches, supported by the infrastructure connecting data and needs, which become an innovative city planning instrument; the contribution to and analysis of the design thinking process with a specific perspective on the economical and normative background whose knowledge is essential to turn innovation at the urban level into easy-to-build solutions.

Spoke 1 is organized into 5 technological and 1 management work packages (WP), which will involve intra-Spoke 1 coordination and inter-Spoke communication and interlinking.

We want to underline the importance of the complementarity between Spoke 1 and Spoke 2, WP1: Spoke 1 targets communities whose different level of abilities impacts mainly on their experience of the city and social communication, while Spoke 2, WP1, primarily targets the extension of the health care monitoring services to the home environment. The boundary between the two contexts is obviously blurry, because pathological and non-pathological cases blur themselves. There is also an important complementarity to underline concerning the scope of Spoke 3 on environmental

care supported by innovative monitoring systems. Here, again, the activity planned in Spoke 1, WP2, touches issues relevant for environmental monitoring, but brings the problem down to the scale of assessing the micro-climate or climate at the urban scale.

The planned activities will be complemented by actions implemented by the mechanism of “Cascade Funding”: this will be aimed primarily at recruiting a team of young researchers to train specifically on the interdisciplinary topics suggested by the spoke 1 theme, with particular attention to gender balance (the female leadership of the WP is expected to facilitate the attraction of more female researchers in the Team). Cascade funding will also be used extensively to solicit participation of start-ups and companies to the Pilot implementation, for which specific skills and services are likely to be needed. This includes ad hoc services to host/support high-speed communication that will be sought in the spoke area of activity and jointly with spoke 5.

#### 2.1.2.1.1 WP1 – FROM USER COMMUNITIES TO THE DESIGN OF INCLUSIVENESS

Objective: development of multimodal approaches for analysing the needs of target subjects and for measuring and evaluating individuals’ response to psychophysical multisensorial, motor, and cognitive skills.

WP1 will drive the design thinking approach and finalize the use cases (pilot planning and functional design of the technological solutions). WP1 will design methods for quantifying the “humans’ state” in case of typical and impaired situations (measuring the sensorimotor, cognitive abilities, and frail conditions). In-depth analysis of skills and their reaction to stimuli will be coordinated, addressing the various user communities involved (target: children, teenagers, adults, elderly), and technological support, for example, for real-time analysis of non-verbal individual and social behaviour, including cognitive states and emotions. This basic-scientific and user-centred design will guide the identification of the use-case features to be addressed in the pilot development, in terms of sensors to be used, and the parameters to be considered for building a profiled and well-being-oriented mapping of the city status (WP2).

Results: Development of a common framework for designing inclusiveness (knowledge, terminology, metrics); Use case and pilots selection; Methods for quantifying the “humans’ state” in case of typical and impaired situations; Reference framework for impact assessment and prototypes’ assessment.

#### 2.1.2.1.2 WP2 – MAPPING AND COMMUNICATING URBAN WELL-BEING

Objective: Sensors and smart devices for capturing the state of humans and/or of the urban context; Inclusive City Platform and mapping services.

WP2 has the role in the project to build the platform of the inclusive city, that is, a central hub of data and service about the urban spaces that will host the pilots. Sensor networks will be designed and deployed to capture a rich data set about the city status, which will be stored in the inclusive Urban Data Platform (IUDP). The IUDP will follow the European strategy for data (i.e., the Common European data spaces) to ensure availability of the collected data sets for economy and society, while keeping who generate the data in control of it. Sensor data will be accompanied by a detailed 3D acquisition and modelling of the urban spaces, to support solutions and status monitoring design. The data collected will be used and analysed to provide a description, at least, of the degree of well-being that can be associated with a specific user profile; user models, as designed in Task 1.4, will have a certain number of parameters that are known, or identified, as impacting on the perceived wellbeing. WP2 will develop services that will dynamically map the “real-time” state of the urban space concerning these criteria. The data space information can be used to calibrate the response of the devices developed in WP3 to the current state of the physical environment in which they are used, supporting improved dynamism and reactivity.

Results: Services for personalized mapping of city well-being status; Services to communicate about the “inclusiveness city offer” to temporary citizens (e.g., tourists); Informing policymakers about the status of the city (see also WP5); a platform for data lake storage and service deployment (e.g., visual-analytics, predictive simulations).

#### 2.1.2.1.3 WP3 – TECHNOLOGIES FOR INCLUSION AND ENGAGEMENT

Objective: Develop multimodal and cross-modal interaction methods and technologies and novel sensorized materials to foster universal and personalized experiences; robotics systems and devices to stimulate and support sensory and motorial deficits.

WP3 is the forge for novel models, methods, and devices to improve interaction, having in mind usability, efficacy, and non-invasiveness as guiding principles. Research and development are planned to enhance the exchange of content and information during interactions among people across different communication channels (e.g., visual to speech, audio to text, visual to physical 3D prints) and the development of effective multi-modal communication lexicons. WP3 will address the development of sensors for capturing the real-time “human state” during interactions in the real environment

in terms of physiological and emotional status. Devices and services will be designed as reactive to the “indoor/outdoor state,” as captured and conveyed by services developed in WP2. Therefore, the interaction will be conceived to be reactive to the status of the physical context where the interaction takes place. The outcome of WP3 will continuously feed the set-up of the Living Lab and be brought into field experimentation in WP4.

Results: Novel and customized solutions for effective human-device and human-human interaction supported/mediated by smart devices; technological solutions for indoor design models to promote inclusive engagement and sustainable lifestyles, through a wider interpretation of the Ambient Assisted Living (AAL) approach.

#### 2.1.2.1.4 WP4 – URBAN TECHNOLOGIES IN PLACES: EXPERIMENTATION AND VALIDATION

Objective: Pilot deployment and experimentation for the use case selected; Evaluation of the technology and solutions by using quantitative (social interaction, perceptual psychophysical, and gesture improvements) and qualitative (questionnaires, observational measurement) measures to quantify the improvement.

WP4 will be the Proof-of-Concept zone of Spoke 1: the Pilots that will guide the whole programme of activities will be implemented, experimented with, and validated. The timeline of work will start right after the identification of the primary use cases (WP1) and will rely on a tight collaboration with local authorities to ensure proper handling of the technological setup needed and with Third sector associations to ensure involvement and participation in the experimental phase. The validation will be tightly connected with experimentation and involve specialized assessment and a rich impact assessment based on the framework defined and adopted in WP1. The evaluation will cover, with three different tasks, all aspects of the pilots.

Results: Installations in the urban space (indoor/outdoor) of interaction and supportive technologies; Experiment monitoring; Impact assessment.

#### 2.1.2.1.5 WP5 – FROM INCLUSIVE TECHNOLOGIES TO INCLUSIVE SMART CITIES

Objective: Using AI in Smart cities is crucial for modernizing local authorities and creating. The real Smart city is able to build an inclusive urban space involving citizens in its design. Innovative technologies, coupling AI and robotics, can be the new instruments to overcome inequalities, pursuing inclusive engagement and a better quality of life for all people and communities. Including participatory data about accessibility barriers to the plethora of data collected daily by local public administrations, along their administrative processes, constitutes an incredible opportunity to gather in-depth information at all the level of the city life: using AI to optimize and customise the offer of public services becomes the way to reach each citizen in an inclusive and personalised way and to satisfy the everyone’s needs. In the meantime, ad hoc decision support systems can help politicians and public officials to conceive and implement evidenced-based local policies to reduce inequalities and pursue a better quality of life for everybody. However, data availability and advanced AI technologies are not able for themselves to develop citizen-centred AI applications. According to the National Strategic Program for AI, to introduce AI in public administration is of capital importance for the innovation of our nation and community, but it requires to create the preconditions. The public administration needs skills and competences, well designed administrative procedures and adequate tools to adopt such technologies reaching the better economic and social returns and facing problems such as privacy violation, biased political decisions or policies creating socioeconomic inequalities. Therefore, this WP is built to both support the adoption of innovative solutions in urban contexts and to face the risks and consequences connected to its adoption concurrently.

#### 2.1.2.1.6 WP6 - MANAGEMENT AND SPOKE SUPPORTING

Objective: Support a smooth and efficient running of the Spoke work programme and ensure a proper level of integration with the whole ecosystem activities.

The role of WP6 is to provide overall coordination of the spoke team, to monitor the evolution of the WPs programmes and result delivery, and to coordinate the reporting with the Hub. To ensure the proper international visibility and gather feed-back from the scientific communities related to the Spoke topics, an Advisory Board will be appointed and involved in the Spoke life. Identified members, who confirmed the participation and gave therefore the endorsement to the spoke programme are: Prof. Nadia Magnenat-Thalmann, pioneer researcher in Virtual Humans and Social Robots, and Director of the MIRALab Research Lab of the University of Geneva in Switzerland, and Director of the Institute for Media Innovation (IMI) at Nanyang Technological University, Singapore; Prof. Nadia Berthouze is Professor in Affective Computing and Interaction. Her main area of expertise is studying body posture/movement as a modality for recognizing, modulating, and measuring human affective states in HCI at the university college of London. She has pioneered the field of Affective Computing for more than a decade. She has published more than 200 papers in Affective Computing, HCI, and Pattern Recognition.

WP6 will also support the Spoke work programme taking care of all those aspects that impact each WP. WP6 will also coordinate interactions and communication with the whole ecosystem, promoting dissemination events especially for topics representing potential complementarities, and provide a coordinated input to Spoke 5 for technology transfer and for contributing to dissemination and Open Data and Science initiatives.

### *2.1.2.2 Spoke 2 – Smart devices and technologies for personal and remote healthcare*

The SPOKE 2 leverages intelligent and interactive technologies to foster a disruptive paradigm of connected care for the Innovation Ecosystem.

The last few decades of progress in medicine and in medical technologies have greatly extended our life expectancy, with a steady increase in the fraction of the elderly population. It is well known how the world population aged  $\geq 65$  years is projected to almost double in 2050. Italy is almost 30 years ahead of this global trend (22% of the population over 65 in 2020; source: CENSIS) and the situation is even more extreme in the Liguria region (28% in 2020). Considering how older adults are typically affected by chronic diseases (in Italy, 75% of the 65+ population have a chronic disease), the pressure on the healthcare systems keeps rising. Furthermore, the worldwide growing prevalence of chronic conditions requires tools for detecting and monitoring them, especially when they are non-communicable diseases. This current need for health generates a global societal challenge to achieve long-term sustainability in healthcare and welfare systems. Such a challenge became further clear during the COVID-19 outbreak, highlighting a severe lack of resilience that must be corrected through innovative solutions for being ready to counter any emergency.

The ubiquitous and data-intensive intelligent and interactive technologies that characterize the last decade can become the key for enabling a series of breakthroughs to make healthcare services closer to each person, meeting their emergent clinical needs. This is also highlighted by the One Digital Health perspective and is coherent with the guidelines provided by the Italian Ministry of Health about the PNRR initiatives for implementing intelligent systems to understand the needs of fragile and chronic patients through local and remote clinical activities.

The defining aspects of the technology-driven connected care paradigm envisioned in Spoke 2 can be summarized in terms of personalization, prediction, prevention, and participation. In order to encompass these aspects and achieve its goal, the Spoke will address four technological challenges within the Robotics and AI domains: Intelligent and Interactive environments, to provide home services for monitoring and care of frail individuals by means of wearable, environmental sensors, and robot companions, thus facilitating continuity of care between hospitalization and home; Digital twins, to enable customization of medical treatments to individuals based on their unique anatomy, behaviour, and other patient-specific factors. The field is at an early stage but is quickly expanding thanks to the advances in real-time data recordings and machine learning; Rehabilitation ecosystems, to place the technologies for robotic and virtual rehabilitation within the connected care scenario, through interoperable platforms, personalized therapy and hospital-home continuity of care; Future image-based diagnostics to take current ultrasound imaging, magnetic resonance and computer tomography to the next level, using AI techniques to enhance display and sharing of information.

The work plan is organized into four work packages (WP), one for each of the above areas. An additional one (WP5) is devoted to managing the activities that encompass all areas. These WPs are the elements for implementing an ODH-oriented strategy, based on different intertwined approaches that converge into design of a new healthcare architecture. WPs' activities will be carried out by Spoke's partners having outstanding expertise in three areas that are essential for any innovation in healthcare: scientific and technological research, clinical practice, and biomedical industry. Thanks to this synergistic composition, the Spoke is able to develop cutting-edge solutions that exploit the data collected within a network that encompasses the relationships between patients and caregivers, human-sensitive and context-aware robots, intelligent environments, wearable devices, home-testing diagnostics, and imaging equipment.

Across all WPs, we will promote rigorous human-centred design approaches to improve technology acceptance, and to solve ethical issues in data management by using methods of value-sensitive design and privacy-by-design. This is the path we envision for pursuing the goal of proposing a disruptive model that makes healthcare sustainable, feasible, and impactful, thus increasing individual and societal resilience.

#### **2.1.2.2.1 WP1 – INTELLIGENT AND INTERACTIVE ENVIRONMENTS**

Integration of AI and robotic technologies in living environments will adapt the setting to individual needs, enabling continuous remote monitoring, increasing social participation, improving the visual and acoustic quality of communication between people, and, consequently, helping them to conduct an active and independent lifestyle. Homes of the future will include personal robots, personal smart devices, and non-intrusive distributed sensors that, working jointly, can provide for a more accurate data collection and processing to assist users better than when devices are used individually.

Assistive robots have the potential to offer considerable improvement in autonomy and the quality of people's lives. Thus, companion robots can listen, respond to speech, detect touch and light, and help with psychological well-being. Telepresence robot can facilitate communication through a video connection with a person located remotely as well as extend the capability of visiting places outside of his surroundings. Rehabilitation robots can provide physical assistance with mobility problems (as WP3 describes). Furthermore, Artificial Intelligence is a prerequisite for making these agents truly human-sensitive and context-aware in most domains of Activities of Daily Living (ADLs). The interaction of IoT technologies, artificial intelligence and assistive robots can transform the hospital-centred healthcare system into a person-centred healthcare system, based on the smart interplay of long-term continuous monitoring and traditional medical treatments.

The Mission of WP1 is to develop technologies that assist frail people at home, provide personalized care, improved safety, and social interaction. To achieve WP1 mission, we will face 3 Main Challenges:

- 1) Develop connected care platforms based on non-intrusive environmental sensors, wearable sensors, home-testing biomarkers sensing devices, and assistive robots working in daily life contexts. The design of proper communication standards between IoT devices will be crucial, since IoT encompasses a multitude of protocols, formats, and standards and still lacks unified standardization;
- 2) Develop AI-based technologies to process and interpret data coming from the IoT to enable the operation of assistive devices with minimal supervision. Process physiological and behavioural data coming from the IoT network to obtain diagnostic and prognostic information of older people at home and subjects affected by different chronic diseases through non-invasive and ecological measurements. This way, these environments will become sources of information for the Digital Twins of WP2 and the rehabilitation robots of WP3, integrating the imaging patterns of WP4 with ecologically valid data;
- 3) Exploit the connected healthcare paradigm to promote socio-physical interactions. We will target a well-known issue affecting older people: loneliness. Based on the platform personal robots, environmental and wearable sensors, we will design solutions to engage older (and more in general, frail) people at home both physically and mentally, through computer-mediated communication solutions.

To make such systems truly accepted by the user, we will promote rigorous user-centred design approaches. Moreover, across all these challenges, security and privacy will be highly considered.

#### 2.1.2.2.2 WP2 – DIGITAL TWINS

A Digital Twin is a virtual copy of a physical entity (like an engine, a vehicle, a robot or part of it) that is continually updated with its performance and status throughout the physical system's life cycle. A Digital Twin can be analysed independently of its physical counterpart to forecast its status and make informed decisions. Recently, the greater availability of medical data from diagnostic tools (e.g., imaging scanners, lab tests) and from real-time continuous monitoring of conditions (through wearable and environmental devices) made the Digital Twin to emerge as a disruptive concept in healthcare, as well. Digital Twins can operate at different scales (e.g., molecular, cellular, organ, behavioural, and functional) and they are capable of monitoring and predicting changes in each system and, accordingly, personalizing the healthcare interventions. Digital Twins can, in principle, represent individuals and communities, a patient's home and a user-robot dyad, the healthcare system, and, ideally, the ODH ecosystem, enabling an optimal allocation of resources for hospital and home care. Synergistically with different technologies, Digital Twins will support every step of the patient journey by interpreting, for instance, daily events detected in interactive environments (WP1), or imaging patterns (WP4) as important sources of information for the early detection of pathological conditions. Digital Twins of rehabilitative devices (WP3) can also be developed for predicting how human-machine systems can change, offering the opportunity to adjust them to the needs of specific patients.

The Mission of WP2 is the development, validation, and use of Digital Twin technologies for personalized and precision medicine primarily in two clinical fields: neurology and oncology. To achieve WP2 mission, we will face 3 Main Challenges:

- 1) Design and implement computational tools and infrastructures supporting the creation of patient-specific and time-variant Digital Twins at different scales (molecular, cellular, tissue, organ, whole-body) as well as their interactions with the external environment, including, for instance, surgical instruments or assistive and rehabilitative devices (i.e. Digital Twins of human-machine systems);
- 2) Combine Digital Twins with AI tools to optimize human intervention in the medical routine across hospital and home care services, thus leading to increased automation and optimization of processes, supporting clinical decisions, improving treatment efficacy and patient safety;

- 3) Demonstrate the value of the Digital Twin approach in specific clinical use cases, such as patient-specific decision support or virtual testing of therapies and devices.

#### 2.1.2.2.3 WP3 – REHABILITATION ECOSYSTEMS

A variety of technologies are now available to facilitate exercise-based recovery of persons with cognitive, sensorimotor and physical impairments, and to assist them in everyday life. Rehabilitation technologies typically rely on activity sensors and robotic actuators which administer goal-directed exercises, often through interaction with virtual and augmented environments. These devices can be also used to assess users' residual functions and to monitor the progress of recovery. Rehabilitation technologies are commonly used in inpatient and outpatient rehabilitation, but current-generation devices have limited adaptability to individual impairments and conditions, and high costs. Also, their use typically requires the supervision of physicians and therapists. Depending on the type of impairment or injury, the recovery of motor functions can also be promoted through assistive technologies. These typically rely on sensors to identify user activity and intentions for their control and range from prostheses to wheelchairs and computer applications (brain and body-machine interfaces), to robots providing healthcare and social care services. Although the available rehabilitation and assistive technologies are promising, their use is not yet widespread as the translation from the laboratories to the bedside is far from being achieved. The main obstacles to wider use are cost, limited personalization, the need for lengthy training, and the limited sensory feedback they provide to users.

The Mission of WP3 is to promote a disruptive transition of the available technological solutions, enabling their use at care centres or home, with limited supervision by therapists and with a high degree of adaptability to individual needs. According to this, WP3 will face 3 Main Challenges:

- 1) Develop innovative rehabilitative and assistive devices, robots, and other solutions from available proofs of concept, to provide more effective treatment by accurate monitoring of the physiological state (sensorimotor, cognitive and emotional), and through novel physical and social interaction modalities which promote motivation and engagement, also taking into account the cultural background of the assisted person to address the requirements of a multi-ethnic society.
- 2) Extend the application domain of existing devices, robots and other solutions, through feasibility studies with selected user populations. AI-based tools will be used for the personalization of the treatment and for the definition of innovative indicators of clinical and quality of life (QoL) improvement.
- 3) Facilitate the transition of validated prototypes into commercial products which promote continuity of care through integrated platforms and interoperable devices, usable in both hospital, outpatients, and home, with intuitive interfaces which enable remote assistance and tracking of performance and recovery.

#### 2.1.2.2.4 WP4 – FUTURE OF IMAGE-BASED DIAGNOSTICS

The area of AI in healthcare has seen rapid developments due to the increasing availability of health data, combined with unprecedented advances in AI and computation capabilities. AI systems can support humans allowing to optimize the diagnostic examination workflow and improve the analysis of diagnostic images. Quantitative information extracted by AI tools can support reporting physicians (radiologists and neuroradiologists, cardiologists, obstetricians, endoscopists, foetal medicine experts) to detect abnormalities not readily visible to the human eye, especially in the case of advanced imaging techniques, such as diffusion, perfusion or functional imaging. Moreover, AI and machine learning (ML) tools allow medical specialists to integrate imaging data with information from electronic medical records (e.g., longitudinal patient data, population health platforms) to provide a rich source of new insights for medical research, such as the identification of new protocols for imaging and patient pathways. AI tools can also be implemented in the workflow and the management of an imaging department, aiming to reduce waiting times for patients, obtain faster patient turnarounds, increase equipment utilization, and reduce staffing costs. Hardware miniaturization embedded computational platforms allow the integration of the developed algorithms in the medical devices themselves to support physicians in real-time. Furthermore, ultrasound (US), magnetic resonance imaging (MRI) and Magnetoencephalography (MEG) devices can be innovated using smart materials to improve their use in diagnostic and interventional imaging, such as stimuli-responsive polymer-based systems, and sensors, such as new contrast agents with reduced toxicological effects.

The mission of WP4 is to develop and validate the next generation of AI to generate novel imaging devices tools and distributed interoperable software platforms, thus supporting screening, early diagnosis, follow-up of diseases, new disease markers and care decision processes.

To achieve this mission, WP4 will face 3 Main Challenges:

- 1) Address the data fragmentation, interoperability, data quality, privacy and protection for the development of US and MRI/MEG devices and for the next generation reporting platform.
- 2) Develop and clinically validate robust, fair and trustworthy demand-driven AI-powered systems for diagnosis, treatment and care, including personalised prevention and risk prediction of diseases. Particular attention will be paid on performance, safety, usability and support on fraud prevention in healthcare.
- 3) Improve the performance of medical imaging devices/techniques and increase the compliance of these devices with different legal and regulatory frameworks on AI and clinical data, and with organizational and financial structures.

#### 2.1.2.2.5 WP5 – MANAGEMENT

IIT will perform the duties reserved for the coordinator, acting as the point of contact for the interface between the Spoke 2 and the Hub, while all partners will provide periodic updates on their progress, contribute to the identification, assessment, and mitigation of risk, and to the management of the project.

#### 2.1.2.3 Spoke 3 – Sustainable environmental caring and protection technologies

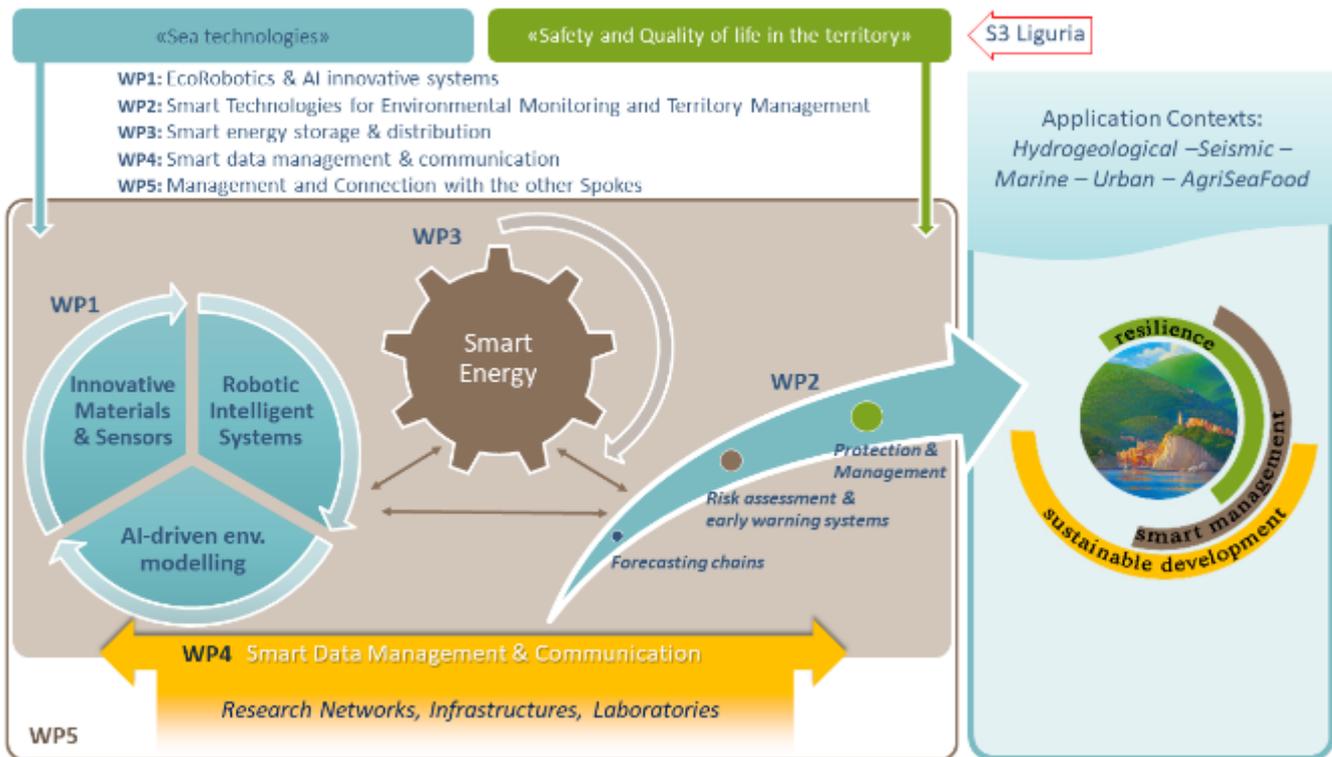
The project pursues the development of an ecosystem of innovation with a network of nature-neutral technologies, for monitoring, preservation, and remediation of different natural ecosystems on land and sea, for the promotion and valorization of the Liguria territory. In particular, the project focuses on the development of ecosystems of robots, sustainable materials and (bio)sensors, AI-based solutions and enabling technologies accomplishing synergistic activities for capillary collection of distributed and varied data, envisioning new strategies for planning and actuation of sustainable management of the territory.

CNR, UniGe, IIT, INGV, ENEA, CIMA, Ansaldo Energia, ETT, algoWatt, Info Solution are the main players of the Spoke 3 and they will work together (in connection with the hub, Spoke 4 and 5) to establish an end-to-end workflow from basic and industrial research to its dissemination and outreach to hub communities.

The following research and development WPs have been identified: WP1 - EcoRobotics&AI Innovative systems - will perform study and development of the software and hardware components that will be exploited in WP2; WP2 - Smart Technologies for Environmental Monitoring and Territory Management - will capitalize WP1 results at the service of the territory; WP3 - Smart Energy Storage and Distribution - will address innovative management platform to optimize energy management in the smart grid; WP4 - Smart Data Management and Communication - Platforms and processing pipelines for the data lifecycle; WP5 – Management and Connection with the other Spokes – will perform management and coordination activities. WPs interaction is described in the following scheme where the cascade process based on Eco-robotics and AI, integrated with existing territorial research infrastructures (i.e., BlueLabnet, Seismic network, Smart Bay and LTER network), will drive the development chain of environmental applications.

#### Spoke 3 - Key Performance Indexes

Number of data acquisition campaigns; software/hardware/dataset releases; Data linked to/uptaken by EMODnet/CMEMS; submitted/published patents and scientific publications; deployed setups; tests on the field; end-users involved in tests; number of third parties and industrial partners involved in cascade funding and in technology transfer; posts on social media; dissemination events; appearances on the media; submitted and approved projects on these topics at national and international level; TRL improvement.



#### 2.1.2.3.1 WP1 – ECOROBOTICS&AI INNOVATIVE SYSTEMS

This WP develops sustainable monitoring systems, biomaterials, robotic platforms, early warning systems and AI-techniques to autonomously and synergically patrol large areas, acquiring data for hydrogeological risks prevention, damage mitigation, ecosystem restoration and garbage collection. We will consider classic robotic vehicles for sea, terrestrial and aerial navigation, as well as new bio-inspired, soft, and/or biodegradable robots, arms and manipulators. AI and ML techniques will be exploited to collect, analyse and make a smart use of the enormous data streams coming from different robots and sensors.

#### 2.1.2.3.2 WP2 - SMART TECHNOLOGIES FOR ENVIRONMENTAL MONITORING AND TERRITORY MANAGEMENT

The specific/innovative techniques and components developed in WP1 in relation to AI, robotics, smart sensors and their synergistic combination, will be capitalised in WP2 at the service of the territory, in relation to monitoring and risk assessment, safety and protection. The technology transfer toward the territory will not supplant but rather blend into the traditional practices, bringing forward a real paradigm shift. This revolution will emerge both in terms of performance and reliability of the system as well as in terms of energy autonomy guaranteed by modern energy harvesting techniques developed in WP3, with a key role played by the availability in real time, modulated in space and time where needed, and with human intervention reduced to a minimum, of a huge amount of observed data. These latter will allow not only a monitoring of the territory with an unprecedented wealth of detail but they also allow predictions of the future state of the main environmental parameters with accuracy unimaginable for us today. At the base of this revolution will be placed the activity of WP4 that will ensure the state-of-the-art technology for the transfer of observed data collected by the innovative sensors to a regional hub where data will be handled, processed, also for early-warning activities.

#### 2.1.2.3.3 WP3 - SMART ENERGY STORAGE AND DISTRIBUTION

AI and stochastic techniques will be applied as tools for automatic decision support at different spatial and temporal scales for the management, adaptive control and prediction of energy demand and production from renewable sources (wind, solar and geothermal). The scope of application ranges from the production from renewable sources (from the scale of milliwatts to supply distributed sensors to megawatts) up to management systems and building automation (home automation). The WP will also deal with the optimization of innovative systems for the management of the storage of energy through lithium storage systems, super cap and through electrochemical systems of electrolysis and co-electrolysis powered by renewable energy for the production of "green" hydrogen. Quality of Service (QoS) and safety in telecommunications networks for the control of electrical and industrial networks.

#### 2.1.2.3.4 WP4 - SMART DATA MANAGEMENT AND COMMUNICATION - PLATFORMS AND PROCESSING PIPELINES FOR THE DATA LIFECYCLE

The creation of "value" through the use of analytical tasks over large quantities of raw data is made effective and efficient thanks to a complex data life cycle that foresees, in the initial phases, data acquisition and wrangling (i.e., cleaning, transformation, and integration) and, before analytical tasks, a preliminary data exploration through data visualisation tools. WP4 aims at providing such cross competencies by designing (i) large scale data processing platforms, (ii) data wrangling pipelines, and (iii) data visualisation approaches for data generated by WP1, considering the analytical tasks proposed in WP2 (and WP3).

#### 2.1.2.3.5 WP5 - MANAGEMENT AND CONNECTION WITH THE OTHER SPOKES

CNR and the research affiliates UniGe and IIT (with the participation of all the other affiliates) will coordinate the Spoke activities to ensure the immediate set up of the work plans of WP1-4, and to continuously monitor the progress of activities, issuing the calls for projects and services (for external parties, in particular SMEs), establishing and animating an Advisory Board at Spoke level, scheduling advanced training initiatives, and interacting with the hub and spokes 4 and 5. The Spoke Advisory Board will meet every 3 months, also to address the competitive cascade calls that will be issued for the implementation of activities and the provision of services by external parties. Under this work-package, also the administrative tasks (mainly related to the reporting of costs and expenses) will be carried out.

#### 2.1.2.4 Spoke 4 – Smart and sustainable ports

Spoke #4 “Smart and Sustainable Ports” (UniGe) has the objective of creating an ecosystem of innovation for the several port areas in the territory of Liguria region. New levels of automation, innovative technologies for collecting data, smarter and optimized processes will be introduced and applied to the big maritime ports (Genova, La Spezia and Savona-Vado) and to the medium/small ones (in the two Rivieras of Liguria region), aiming at reducing the environmental impacts of port activities, improving safety and security, creating a less stressful work environment, defining a new way of experiencing the port within the city. The spoke UniGe, research affiliate spokes CNR, IIT, INFN, industrial affiliate spokes Aitek, algoWatt, Circle, EII, Fincantieri, Leonardo, and the public affiliate spoke ENEA, are the main players of this “innovative port ecosystem” and they will work together (also in connection with the hub and spoke #5) to carry out research and industrial projects, develop technologies, set living labs and demonstration areas, disseminate results to the scientific community, industrial associations, and citizens.

Four strategic lines of research and development have been identified and a specific work-package (WP) has been assigned to each of them:

- “Uncrewed and automated systems for port automation” (WP1)
- “Machine Learning and real-time data for port safety, security, and sustainability” (WP2)
- “Port optimization in an integrated framework of transport infrastructures” (WP3)
- “AI-powered services for medium and small ports” (WP4)

WP1 is aimed at increasing the level of automation of port processes and activities also through the introduction of robotic systems (terrestrial, marine and underwater, aerial) that operate in the port area. In WP2, several data and signals will be collected from various heterogeneous sources (also exploiting the resources introduced in the first work-package) and they will be analysed for the purpose of traffic monitoring, marine and weather forecast, sustainability evaluation, risk assessment, port protection and infrastructure maintenance. WP3 has the objective of optimizing the performance of the port from many points of view (management, environmental, energy), also exploiting the data collected and analysed in the second work-package, and even making use of virtual models and digital twins; in this connection, ports are considered in a systemic view as nodes of a regional network of transport infrastructures. Finally, WP4 considers the application of all these robotics and AI-based approaches to medium and small ports and to their peculiar activities like those relevant to tourism and recreational boating.

WP1-4 are carried out under the supervision of a fifth work-package, WP5 “Spoke management”, whose tasks are those of monitoring the progress of activities, issuing the calls for projects and services (for external parties, in particular SMEs), establishing and animating an advisory board at spoke-level, scheduling advanced training activities, and interacting with the hub and spoke #5. Following are reported topics and activities that will be carried out in each work-package.

#### 2.1.2.4.1 WP1 – UNCREWED AND AUTOMATED SYSTEMS FOR PORT AUTOMATION

This work-package relies on two main pillars: i) an increase in the adoption of smart/green vehicles (terrestrial, marine and underwater, aerial) for port logistics and services; ii) the exploitation of AIs’ potential to control the fleets for a safe

and green lifecycle management of the assets. The goal is to provide an integrated infrastructure of cooperative autonomous vehicles able to accomplish land-based, harbour and coastal services.

#### 2.1.2.4.2 WP2 – MACHINE LEARNING AND REAL-TIME DATA FOR PORT SAFETY, SECURITY, AND SUSTAINABILITY

This work-package focuses on the development and use of AI&Robotics technologies for port safety, security, and sustainability. This includes intelligent, IoT-based solutions to localize, track, and recognize in- and out bound flows of vehicles and persons; data-driven models for nowcast and forecast of marine conditions including weather, fauna, and pollution; tools to evaluate energy consumptions and emissions, as well as for monitoring acoustic signals for workers' health; intelligent sensor networks for port protection; teams of aerial and ground robots for monitoring and inspection of shipbuilding activities, port areas and goods.

#### 2.1.2.4.3 WP3 – PORT MANAGEMENT IN AN INTEGRATED FRAMEWORK OF TRANSPORT INFRASTRUCTURES

This work-package is aimed at designing and developing AI methods and tools for optimally managing transportation networks embedding maritime terminals. The line includes both approaches devised for ports as nodes of the integrated network (as the integration of new and smart solutions inside TOSs, advanced AI and IoT schemes for improving processes, solutions for energy and resource efficiency), and methods and tools for transport networks (as advanced monitoring, forecasting and optimization of flows of goods, approaches for reacting to disruptions).

#### 2.1.2.4.4 WP4 – AI-POWERED SERVICES FOR MEDIUM AND SMALL PORTS

This work-package is focused on the critical issues related to the optimal scaling of technological services for small and medium sized ports, in order to allow players with limited expertise in assessing alternative technological solutions to promote customized and advanced tools. As such, the SL boosts activities connected to specific local challenges, such as the issues related to verbal and non-verbal interaction with humans (e.g. application to the tourism sector), the monitoring of environmental performance, the development of ad-hoc technologies applied to the recreational industries, and the proper assessment needed for the deployment of the differentiated solutions proposed in other work-packages (e.g. non-technological factors, replicability assessment, scaling-up analysis, support for optional decisions).

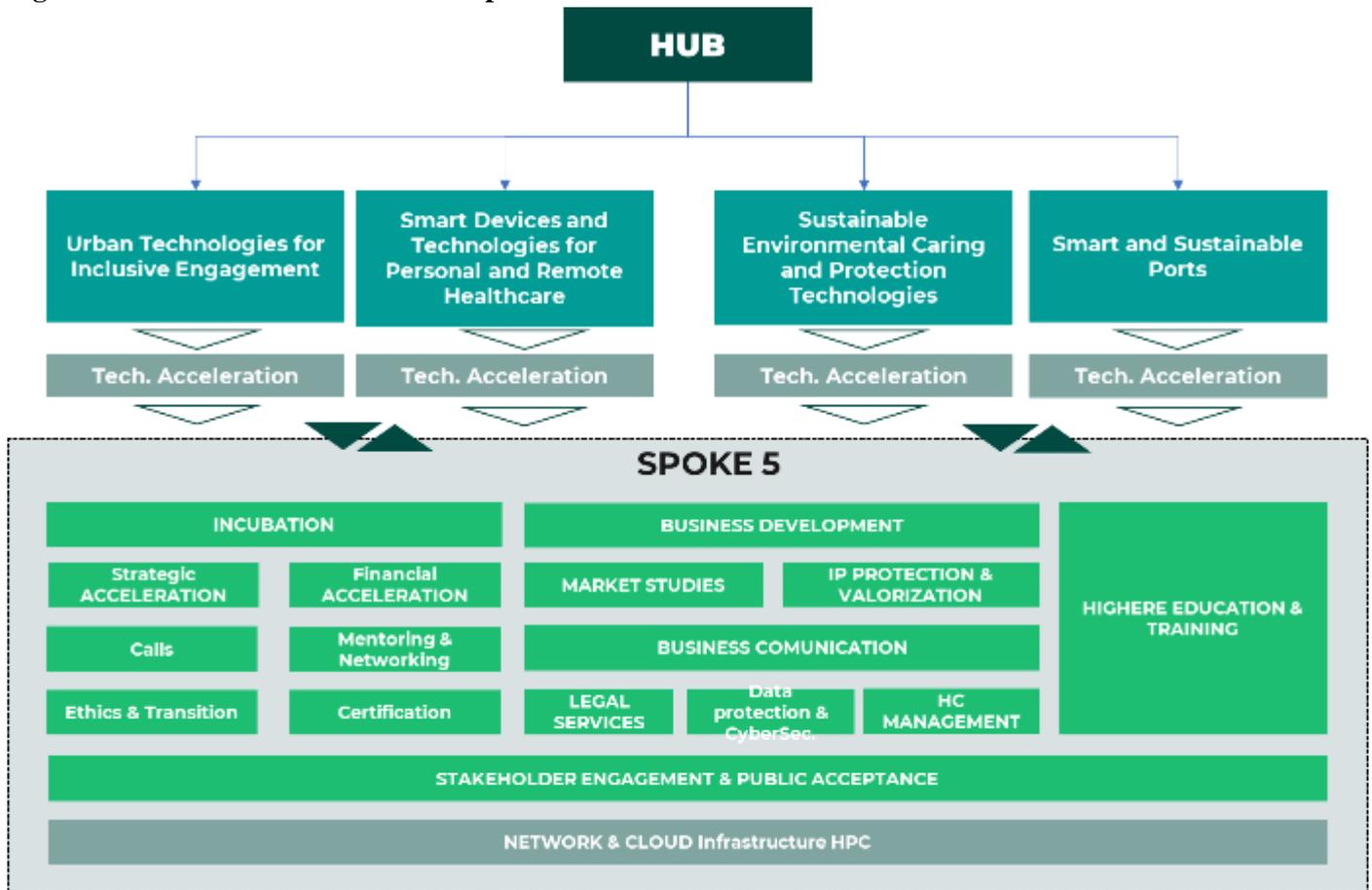
#### 2.1.2.4.5 WP5 – SPOKE MANAGEMENT

Spoke UniGe and the research affiliate spokes CNR and IIT (in collaboration with all the other parties) will coordinate all activities to ensure the immediate set up of the work plans of WP1-4, and to progressively monitor the implementation of the projects. Under this work-package, also the administrative tasks (mainly relative to the reporting of costs and expenses) will be carried out.

#### 2.1.2.5 Spoke 5 – An engine for knowledge and technology transfer

Component “2” of the PNRR, 4th Mission (Education and Research - From Research to Enterprise) aims to support the synergetic research relation between universities and enterprises and to develop technology transfer activities. In this perspective, we have focused on a technological domain where our regional area truly expresses the best of its internationally acknowledged scientific value and its private sector its most established industrial tradition. We have therefore designed Spoke 5 as a facilitator between business and the technological outputs of thematic spokes, as illustrated in the diagram below. In detail, the first column on the left shows the services offered to companies willing to adopt the technologies of the ecosystem, the middle column services and functions acting as an “engine” for knowledge and technology transfer, and the last column the knowledge transfer contribution towards human capital, as a multiplier and a long-lasting social and economic legacy of the ecosystem (see following figure **Errore. L'origine riferimento non è stata trovata.**).

Figure 4 – Structure and functions of Spoke 5



The Spoke 5, thus conceived, gathers the typical tools of an “accelerator” aimed at amplifying the economic and social impact of the technological solutions, designed and implemented within the ecosystem. The Spoke 5, in fact, aims at fulfilling the need for transferring technology and knowledge to the market, as well as providing managerial and technical training activities on human capital, so as to make the area's endowment of skills capable of withstanding the global competition. The intrinsic characteristics of the local market make it the ideal candidate site of experimentation and validation to develop products and services able of competing at an international level. The Spoke is led and coordinated by the Italian Institute of Technology (IIT) for its institutional focus on Technology Transfer issues and the results it has achieved in this area. The Italian Institute of Technology is one of the most active research centres on the topics of Robotics and AI at international level as can be seen in its institutional profile included in this project. Therefore, beyond IIT, Spoke 5 sees collaboration with founders of RAISE and will be use of the experience in Knowledge Transfer and Dissemination processes of the National Research Council (CNR) and the University of Genoa, which a high-quality training capacity on the topics of Robotics and Artificial Intelligence. The founders are joined by ETT, a company focused on innovative dissemination systems, and the AFS, which has developed some of Italy's most important scientific dissemination events.

#### 2.1.2.5.1 WP1 – ACCELERATION SYSTEM

Acceleration services aim to support the transfer of technological solution developed by the thematic Spokes and strengthen the attractiveness of the ecosystem from a national and international perspective. These services will support the subsequent stages of technology transfer and would like to accompany technological solutions out of the thematic spokes to the market, to the industry and SMEs and encourage their adoption through technical, financial and training support mechanisms and the protection and exploitation of intellectual property.

#### 2.1.2.5.2 WP2 - INCUBATION SYSTEM

Some of the technological solutions resulting from the research activities of the thematic spokes might merit an internal development process leading to the generation of a market initiative as a start-up. A business incubator for early-stage

start-ups, is a physical place where entrepreneurs find the facilities, services, and skills they need to develop their business ideas and turn them into sustainable reality.

#### 2.1.2.5.3 WP3 – ETHICAL AI & ROBOTICS

The pervasive and disruptive nature of artificial intelligence presents an unprecedented opportunity to change the narrative of humanity's future. Consequently, governments, private enterprises, the corporate sector, and the citizens alike must collectively foster, perpetuate and implement an ethical ai culture.

#### 2.1.2.5.4 WP4 – ECOSYSTEM IDENTITY

The ecosystem is well defined on a specific area that expresses a capacity for research on the topics undoubtedly unique in Italy, but we have to develop a recognizable identity at national and international level. To do so effectively, the ecosystem should have its own capacity to develop a strategy and a development process to make it a stable interlocutor for the industrial system and national and European institutions.

#### 2.1.2.5.5 WP5 – COMMUNICATION & PUBLIC ENGAGEMENT (CPE)

This WP is dedicated to the development of an effective strategic communication and public engagement plan in order to placing stakeholders, decision makers, public administration and citizens by improving public attitude to consider fundamental for the future, the science and technologies for environment and health protection. The activities will be organized to reach the business and social sectors with differentiated communication strategies.

#### 2.1.2.5.6 WP 6 – HIGHER EDUCATION & TRAINING

Our vision is to support people to develop basic and advanced digital skills, while bringing and encouraging all potential users – especially SMEs, companies from non-tech sectors and public administrations – to test and use AI and robotics. In this WP, we will deliver higher education and training targeted to young students, workers, SMEs and the public sector, from an ethic, economic, technical and multi-perspective point of view. Helping people to develop skills which are necessary to maximize AI exploitation, complementary to and that cannot be replaced by any machine such as critical and cross-cultural thinking and creativity. Another key goal will be to support the growth of a culture of innovation, of the right mindset and the most important skills to found and manage a successful start-up.

#### 2.1.2.5.7 WP7 – GOVERNANCE AND MANAGEMENT

This spoke dedicated, in fact, to the transfer of knowledge but much more to support the creation of a new type of industry where robotics and AI support our companies to compete and become a reference point of what we could call the "robotic transformation". The coordination of IIT should be accompanied by a system of shared decision making that should be able to point out the different nuances of doing research and technology transfer of the founders and for this we will give a system of governance and consultation that does not neglect a shared mechanism for making strategic decisions and ensure a correct filling system. In addition, it is necessary to develop an adequate impact assessment system to analyse the quality of the tools used and to correct the action during the investment program.

### 2.1.3 Objectives of the programme

The deliverables detailed in the workplan description of each SPOKE (see paragraph 3.4.1) contribute to the achievement of the programme objectives that will be monitored and measured through the families of KPIs and core indicators described in paragraph 3.9.

In general terms, RAISE intends to build a stable, structured and sustainable ecosystem over time, by enhancing and networking all the skills available in the area, thus creating the conditions for experimenting, applying and disseminating the know-how technologies developed.

The extensive network of living labs and open infrastructures that will be created through the project, together with the involvement of SPOKE member companies and SMEs that will be engaged through the various waves of Open Calls (accelerator grant, POC) and the other institutions involved (local authorities, hospitals, institutions engaged in the dissemination of scientific culture, schools, etc.) will make it possible to build the conditions to

- educate a new generation of scientists and technologists in the field of robotics and artificial intelligence;
- create an open platform for sharing data and making results available on a large scale, create the conditions for new research and development partnerships;
- test the new technologies developed in 'real' environments (the city, the port, inland areas, etc., domestic environments) based on the vertical lines identified in Spokes 1-4;

- create the best conditions for speeding up the go-to-market of the technologies developed through the activities of SPOKE 5 (market research, technological due diligence, protection and exploitation of IPR, support for the creation of start-ups, POC, ...);

- create places and tools for the dissemination of knowledge to the general public, policy makers and students to create awareness in the use of robotic and AI technologies. Specifically, the RAISE ecosystem sets the objectives listed below, which have been identified in order to maximise the socio-economic impact of the programme on the reference territory:

#### Research and development

- Number of scientific publications (e.g., joint public-private publications)
- Number of research contracts (new collaborative projects involving RAISE Partners and entities external to the ecosystem)
- Number of calls launched (accelerator grants, POC grants) through cascade funding and number of SMEs engaged

#### RAISE Observatory

- Number of demonstrators/prototypes
- Open data platform, public data sets, tools, and software
- Number of open-source software disseminated to companies with a proven impact (e.g., number of downloads, customizations, licensing)
- Number of living labs, shared labs, joint labs

#### Training

- Number of training and educational events (Master, industrial, show-cases, ...) and number of participants in training activities
- Number of PhDs involved
- Indicators showing RAISE's involvement in advanced training on its technological topics and applications

#### Technology Transfer

- Patent applications and patents awarded in key enabling and future emerging technologies
- Patent applications and patents awarded in different enabling and industrial technologies
- Number of invention disclosures and patents filed
- Number of start-ups created and connected investments
- Number of IPR exploitation contracts and income (Euros) from IPR enhancement
- Number of prototypes and testing activities
- New products, processes, and methods launched into the market
- Number of projects to create and/or support technology companies
- Policy documentation and guidelines
- Number of occurrences of tangible specific impacts on regional and/or national policies resulting from technical and scientific support provided by RAISE

#### Public engagement: dissemination and outreach activities other than peer-reviewed publications

- Number of dissemination events and participants
- Web Site: number of visitors, downloads of reports and/or videos
- Open Innovation Platform: number of users, matchmaking, ...
- Social media: number of posts, followers, ...
- Media relations: number of press releases, media, flyers, newspaper articles, ...

#### Attractiveness and collaboration

- Growth of the number of research involved

- Growth of the number of young researchers
- Growth of the number of women in the ecosystem
- Number of new international collaborations
- Number of collaborative projects funded with ecosystem grants, number of POCs funded for the creation of an effective collaboration system for technology transfer
- Number of medium to long-term strategic partnerships with EU/IT companies
- Number of scientific visiting to RAISE research laboratories

#### Personnel

- Number of researchers undertaking international mobility under RAISE recruitment calls
- Number of researchers undertaking mobility between academic and non-academic sectors
- Number of researchers who have access to research infrastructures through support from RAISE
- Number of PhD students and postdoctoral researchers supported by RAISE

#### Gender

- Percentage of women participants in RAISE projects
- Percentage of women appointed in RAISE
- Percentage of women in RAISE advisory groups, expert groups, evaluation panels, individual experts, etc.
- Percentage of projects taking into account the gender dimension in research and innovation content

#### From research to market application

- Percentage of innovation projects actions RAISE
- Percentage of RAISE financial contribution focussed on demonstration activities
- Number of projects with a demonstrable impact on regulatory practice regarding AI and robotics in RAISE spokes

#### Financial impact

- Total investments mobilised via debt financing and Venture Capital investments
- Number of organisations funded and amount of private funds leveraged
- Percentage of participating SMEs introducing innovations to companies or the market
- Statistics on growth and job creation in participating SMEs
- Number of cooperation agreements between research, innovation, education and business to create more jobs and increase economic competitiveness (start-up, spin-off, patents, new products)

## ***2.2 Previous experiences, scientific/entrepreneurial skills; activities related to technology transfer, digital transformation, high school education, applied research and innovation activities carried out in the last 10 years, as well as the management and implementation skills dealing with complex projects, and projects of excellence carried out also in cooperation with the research system, the production system and the local institutions***

### *2.2.1 Participant 1 – Università degli Studi di Genova: proponent, HUB founder, SPOKE 4, affiliated to SPOKE 1, 2, 3 and 5*

UniGe is a public institution, one of the oldest great European universities. UniGe has campuses in Genoa, Imperia, Savona and La Spezia. It hosts 22 departments within 5 schools, 13 interuniversity research centres, 1 Centre of Excellence. Its educational offer counts 132 Bachelor and Master courses, 28 PhD courses organized in 90 curricula, 44 specialization schools, 27 I and II level Masters and 5 Libraries. Its Teaching and Learning Centre organizes and

manages all the teaching innovation and faculty development activities, and the Long-life learning Office supports and manages all postgraduates and executive learning projects, in collaboration with enterprises. Within FP6 UniGe was awarded 92 projects, 115 contracts within FP7, 94 contracts within Horizon 2020 and, up to now, 3 contracts within Horizon Europe. Since 2014, UniGe has been awarded 26 projects within other research EU Programmes. Regarding international cooperation programs, since 2000, UniGe has had 433 projects and is currently involved in 81 projects. The main ones are ERDF Interreg Programs (146 projects since 2000, 43 in 2007-2013 and 76 in 2014- 2020); Life Program (31 projects within the three last programme periods, of which 12 under LIFE+ and 9 under Life in 2014-2020) and US Research Programs (57 projects, 30 in 2014-2020). Since 2014, the Italian Ministry of Research funded 143 UniGe projects (PRIN, FISR, SIR, etc.). At the same time private Foundations funded 50 projects. UniGe started two strategic Centres based on a cross disciplinary approach to teaching, research and third mission: the *Centro del Mare*, related to the Sea, and the *Centro sicurezza, rischio e vulnerabilità*, on Security, Risk and Vulnerability issues. The Departments of Physics and Department of Neuroscience, Rehabilitation, Ophthalmology, Genetics and Maternal and Child Sciences were appointed Excellence Departments 2018-2022 by MUR. *Research* activities at UniGe stems from regional vocations, economic and social value for the area, and the focus on solving complex emerging problems with high technological content, to foster activities with industry. Relevant topics include artificial intelligence and robotics; the sea in various forms including environmental, productive, recreational and social; security in various forms including civil/infrastructure protection, cyber/territorial security; quality of life, health, sustainability, aging population, silver economy; tourism and enhancement of cultural and territorial heritage.

### Technology transfer (TT)

UniGe has extended experience in technology transfer, channelling basic research into new technologies with direct impact to the productive and social sectors, and strengthening synergies with the regional innovative system. The Research and Technology Transfer Valorisation Office promotes entrepreneurial culture and intellectual property valorisation among researchers to enhance innovation culture and patent applications. The TT office supervises inventors, contributes to costs through different fundings and supports patents' adoption by publishing them on specialized websites on thematic catalogues and supporting innovation demand and offer matching. UniGe excels in science and technology with synergies with research organizations, SMEs and industries in Liguria and worldwide. Research excellence gave rise to new technologies with 114 patents, often in co-ownership/collaboration with companies or research bodies. Since 2007, research exploitation through spin-off creation and support has been one of the main TT Office activities. It provides operational support during establishment, information on funding opportunities and promotes spin-offs at events and fairs. UniGe promotes start-ups creation with two annual competitions and improving TRL through proof-of-concept programs. Thanks to this huge investment, 50 spin-offs were founded in the last few years. UniGe is active in EC Framework as well as national and international research programmes. UniGe promotes technology creation through the main national and international research programs and has a large network of innovative SMEs and industries in Liguria and worldwide. It collaborates with accelerators and incubators to support regional entrepreneurial initiatives and attract investments. UniGe participates in the EIT Digital and in the following National Technology Clusters: intelligent factory, smart communities' technologies, aerospace, Blu Italian growth, energy and technologies for cultural heritage. To promote good practices in technology transfer, UniGe collaborates with Netval, a network of Italian universities and institutions for Research Enhancement, and with ASTP-Proton, a European network of technology transfer offices - public research bodies and universities.

### Focus on AI & Robotics

UniGe has a long-standing history of excellence in AI & Robotics; the pioneering work of Tagliascio and Borsellino almost 50 years ago laid the ground of the field called cybernetics, which was to become AI. UniGe is now at the cutting edge of modern AI & Robotics. It counts over 50 faculties and 200 researchers working on a wide range of topics. On the one hand core foundational questions in machine learning, symbolic AI, computer vision, embodied AI, bio-inspired AI, including methodological aspects that are key in robot design and development. On the other hand a number of AI and robotics applications including marine robotics, health and wellbeing, emergency management, environment and sustainability, social and public sectors, telecommunications, IoT, security, and countless industrial applications. UniGe is a national and international leader in AI and Robotics, it is often featured in major national and international media outlets. UniGe researchers regularly publish in the most important AI & Robotics venues. UniGe is part of both CLAIRE and ELLIS, the two main European AI networks, and the European robotic network euRobotics. In particular, UniGe co-hosts with IIT one of the four Italian Ellis units and was indeed the first unit in Italy. UniGe researchers are active in the Italian artificial intelligence association (AI\*IA), and the Italian Institute for Robotics and Intelligent Machines (I-RIM). Since 1999 UniGe has directed the interuniversity research centre on Integrated Systems for the Marine Environment (ISME), including nine Italian Universities with excellent international/national fundings, and a joint lab

with the Italian Navy (SeaLAB) supporting its experimental research. Since 2014 UniGe has hosted the interuniversity research centre on Robotics and Autonomous Systems in Emergency Scenarios (RASES) promoting Robotics solutions to manage emergencies following natural hazards. In 2019 UniGe launched the Machine Learning Genoa centre (MaLGA), a research centre between the Department of Informatics, Bioengineering, Robotics and Systems Engineering and the Department of Mathematics, with 14 faculties and around 40 researchers/ students. MaLGA raised almost 7 millions of basic research fundings and half a million based on joint labs with industrial partners. There are currently two ERC consolidator grants specifically on AI and machine learning at UniGe. AI and robotics is a key strategic research field for UniGe and is responsible for a significant part of the exploitable results: around 50 patent applications (of 114 total) and 20 spinoffs companies (of 50 total) are related to AI and robotics. Over the years, UniGe promoted collaborations with industries through joint laboratories to train new professionals with advanced AI for industrial applications. An example is the Railway Artificial Intelligence and Data Analysis Laboratory, between UniGe and Hitachi Rail, targeting AI for the railway sector. Other examples include joint labs with AXPO and Duferco Energia among others. UniGe's educational offer in AI and Robotics includes Ph.D. courses and schools on Deep learning, Machine learning, computer vision and robotics attracting every year hundreds of students from all over Italy and Europe. UniGe hosts one of the largest Italian Ph.D. programs in Robotics (and Bioengineering) with a consolidated tradition dating back to 1991. The program is leading edge in education and research, covering multi-disciplinary scientific and technological domains from advanced robotics, to biomedical engineering, to humanoid and interactive technologies and applications. UniGe offers a master in data science and engineering with a dedicated AI track. The course is in English and has over 100 students, 50% from abroad. Robotics Engineering is a program with over 100 students from all over the world and associated with two international programs: the European Master on Advanced Robotics (EMARO) and the Japan-Europe Master on Advanced Robotics (JEMARO).

### *2.2.2 Participant 2 - Consiglio Nazionale delle Ricerche: HUB founder, SPOKE 1 and 3, affiliated to SPOKE 2, 4 and 5*

The National Research Council (CNR) is the largest public research institution in Italy, the only one under the Research Ministry performing multidisciplinary activities.

Founded as legal person on 18 November 1923, CNR's mission is to perform research in its own Institutes, to promote innovation and competitiveness of the national industrial system, to promote the internationalization of the national research system, to provide technologies and solutions to emerging public and private needs, to advice Government and other public bodies, and to contribute to the qualification of human resources.

In the CNR's research world, the main resource is the available knowledge which means people, with their skills, commitment, and ideas. This capital comprises more than 8.000 employees, of whom more than half are researchers and technologists. Some 4.000 young researchers are engaged in postgraduate studies and research training at CNR within the organization's top-priority areas of interest. A significant contribution also comes from research associates: researchers, from Universities or private firms, who take part in CNR's research activities.

CNR brings core competences to the digital transformation envisioned by RAISE: the methodological know-how is coupled with a long-standing experience in the application fields addressed by the spoke programmes, which is demonstrated by the presence of the CNR in all Ligurian innovation hubs and districts. The organizational structure of the CNR, with its institutes located across the whole national territory, will channel to RAISE not only the core competences of the scientific structures located in the Liguria, but also leverage on the CNR collective knowledge contributing to the RAISE's goals.

At the national level, CNR is fostering the shift from Smart City to "Intelligent and Inclusive Cities", where several digital twins replicating city layers are interconnected to support optimal decision-making and participatory urban design, through an in-depth analysis of citizens' needs in terms of social inclusion and usability of the city and its services. The key competencies for this role are identified in the presence of several local scientific structures that contribute substantially to the development of digital transformation in urban management as a strategic project of the CNR (Dept. of Engineering, ICT, and Technologies for Energy and Transport) with a focus on modelling/analytical aspects and advanced sensors. Furthermore, the Ligurian CNR has distinctive competencies in promoting innovation in the field of urban inclusion, and in particular educational innovation (Dept. of Human and Social Sciences and Cultural Heritage).

Furthermore, CNR has a strong experience in applied and synergistic research to develop innovative discipline, Eco-Robotics: artificial intelligence and robotics at the service of the environment. The skills of the various CNR institutes involved in RAISE (Dept. of Earth System Sciences and Environmental Technologies, Dept. of Engineering, ICT and

Technologies for Energy and Transport, Dept. of Physical Sciences and Technologies of Matter, Dept. of Chemical sciences and materials technology and Dept. of Social Science and Humanities, cultural heritage) will contribute to the development of innovative methodologies and advanced autonomous robotic systems for environmental monitoring and the prevention of natural and anthropogenic risks of terrestrial, coastal and marine ecosystems with the aid of sensors, biosensors, Early Warning System of new generation using innovative approach an materials.

CNR will contribute substantially to high-level training in the areas of intervention of RAISE: the long-standing tradition of tight collaboration with the academic world is demonstrated by the several framework agreements between CNR and the major universities in Italy, UniGe being one of them. In this general, context, the local scientific structures have relevant track records in terms of Ms and PhD thesis conducted in the area of work of RAISE, including Industrial Doctorate programmes, and participate to training courses at all levels. The attractiveness of CNR for high-level training, at the local level, is also demonstrated by co-tutele agreements signed with international universities and the constant presence of foreign students in our institutes. CNR local structures have also an excellent track record of concerning high-school training: only public scientific institute in Italy entirely devoted to studying how ICT-based tools and methods can enhance and innovate teaching and learning processes is in the CNR team sustaining RAISE.

Furthermore, CNR has a consolidated expertise on the management of innovation and technology transfer processes, and it constantly engages its Research Institute, Department and several Central Offices in such activities. The CNR has high level expertise both on IPR and TT management, project management, partnership between research and industry, start-up, R&D and competitive industrial research, both on R&I policies, and research activities on the economic, social, and environmental impact of R&D for supporting policymaking processes. The strength of the TT office of the CNR has an excellent example in the Liguria territory: CNR is leading the Competence Centre START4.0, one of the centres supported by the Ministry of Economic Development, to strategically support businesses in facing the challenges which the Fourth Industrial Revolution has put into being.

To date, CNR owns and manages an IPR portfolio consisting of more than 300 patent families and several trademarks and plant varieties. CNR supports its inventions thanks to a technology transfer process based on the scouting of scientific results, IPR protection and the commercial exploitation through license agreements and other types of agreement with both national and international industrial partners. CNR has established more than 70 spin-off companies and, in the last two years, CNR's TTO has been managing a specific Proof of Concept Fund – supported by the Italian Ministry of Economic Development – aimed to develop a selection of patented technologies.

### *2.2.3 Participant 3 - Istituto Italiano di Tecnologia: HUB founder, SPOKE 2 and 5, affiliated to SPOKE 1, 3, 4*

IIT is a Foundation, established by the State at the end of 2003, public funded, and regulated by article 14 et seq. of the Italian Civil Code. IIT is predominantly financed by the State with the goal of stimulating technological development, technological training, and higher education, in line with Italy's scientific and technological agenda. IIT's ultimate objective is to foster the innovation and competitiveness of Italy's production system. IIT develops a program of basic and applied research with the aim of transferring research results to companies for commercial exploitation.

IIT's activities include the development of scientific capacity, the construction and maintenance of state-of-the-art research laboratories, the development of excellent practices and positive competition, training and higher education at the postgraduate level, the creation of programs to attract talent, and the broad dissemination of knowledge and scientific results.

IIT operates in four Research Domains (RDs): Robotics, Nanomaterials, Technologies for Life Science, and Computational Sciences, with a distinctive multidisciplinary approach to the pursuit of excellence.

Fourteen years after the inauguration of its headquarters in Genoa, IIT is well into its second decade with a solid critical mass of infrastructure, people, and skills. As of 2022, the Institute comprises five large Centres in Genoa, an additional 11 Centres across Italy, and two outstations in the USA (Boston area), for a total of more than 50.000 m<sup>2</sup> of laboratory space.

IIT's staff comprises around 1.950 people from 64 countries with an average age of 35. Among IIT staff, there are 22 different scientific profiles from medicine to engineering, and around 80 principal investigators, including 32 ERC winners (with more under negotiation).

IIT staff have generated more than 14.500 scientific publications, more than 700 industrial projects, 22 Joint Labs with companies and/or research institutions, 261 European projects, 28 start-ups (with several more business ideas in development), and about 1.000 patents.

### Technology Transfer

Technology Transfer (TT) is a foundational pillar. TT will target two main application areas:

- Translating technologies to industry and to the production system by developing joint research programs with industry and by exploiting IIT's large patent portfolio to create new start-ups.
- We will promote the creation of Joint Labs with national and international companies in all research areas of the Strategic Plan.
- Translating technologies to healthcare by co-designing and transferring IIT technology platforms (e.g. robots, sensors, materials, genomics) to the healthcare sector for innovation in surgery, diagnostics, and therapy.
- Initially, we will promote joint research programs and Joint Labs with research hospitals and clinical research institutes (IRCCS). Subsequently, we will focus on innovation programs with companies. The TT strategy is built on traditional Sponsored Research Agreements with companies, IP protection and consequent licensing, the creation of Joint Labs with companies or research institutions, and the creation of start-ups. In summary, IIT's TT strategy has two main directions:
  - Patenting and licensing: we will structure and expand our industrial network with structured scouting activities and direct outreach actions. This area includes activities to select and actively contact companies to promote IIT's technologies and solutions. In particular, this project aims to increase the number of Sponsored Research Agreements, the value of license agreements, and the number of Joint Labs, as described above.
  - Incubation and acceleration: we will organize our venture capital network with investors, private stakeholders, and new public initiatives (e.g., participation in the European network of Digital Innovation Hubs). This area envisages a structured action to create a business accelerator to multiply the opportunities to transfer IIT's technologies.
- Among the main activities carried out during the last two years, the already rich portfolio of partnerships with funds and institutional players has been further strengthened, and now includes 50+ collaborations: from tech-transfer education for start-ups, to seed and equity investments. This network has allowed the IIT start-up portfolio to grow, reaching the following important milestones:
  - 28 launched start-ups as of December 2021
  - 50+ start-up projects

In the last year 4 new-born start-ups, which have raised a total approximately 16 million €, collected from Italian and international investors, business angel, VC firm and industrial players. IIT TTD is part of a scouting network that helps bring start-up projects towards funding and incorporation. These partnerships include the consolidated relationship with the Luigi Bocconi University, the High-Tech Entrepreneurship Workshop program, developed internally and in partnership with the University of Genoa and the Université de la Côte d'Azur in Nice as well as the Manager Italia Association, the "One start-up, One mentor" program, which provides for the support of a specialized figure for the most promising start-up projects. Moreover, there are various other initiatives to develop the deal flow within the TTD (call for ideas, webinars on entrepreneurship issues, one-to-one meetings with institutional and private investors, networking initiatives in order to build business relationships to develop the IIT entrepreneurial community).

### Focus on Robotics

The Robotics team comprises 239 scientists and PhD students, and 81 technicians. There are 11 Principal Investigators (PIs) and 6 ERC grant holders. The Robotics RD is involved in 27 ongoing European projects and has produced 153 patents. Robotics will continue along the successful path developed in the past ten years. The Robotics RD comprises five Priorities. Mechatronics, Social Cognition and Human Robot Interaction, and Intelligent Companion Robots are predominantly basic-research priorities, for which IIT has already achieved international leadership with its humanoid robots, socially attuned robots, and robotic rehabilitation platforms. These activities will be further strengthened in the new 10.000 m<sup>2</sup> facility in Genoa (CRIS, San Quirico Building) and the additional 1500 m<sup>2</sup> of the CJIR (Centre for Joint Industrial Research), which will also host Joint Labs with, among others, Moog, Camozzi Group, and INAIL in the field of rehabilitation robotics.

The important technological outcomes of these Priorities will include next-generation robots for application in the fields of service robotics, human assistance, and disaster recovery.

The Soft Robotics Priority originates from the pioneering work on the plantoid robot and bioinspired technologies. A new dedicated laboratory with additional staff in the CCT (Morego Building) will strengthen this Priority's activities.

Biomedical Robotics will be the most technology-oriented Priority, developing new technologies for surgery, rehabilitation, and prosthetics in collaboration with a large research network of research hospitals. The Biomedical Robotics Priority will focus on technology transfer (TT) to healthcare applications.

#### Focus on AI & Computational Science

The Computational Sciences RD has grown considerably since its origins in COMPUNET, the computational sciences network launched as part of the 2015-2017 Strategic Plan. The Computational Sciences team now includes 150 scientists and PhD students and 8 technicians. There are 13 PIs, including 2 ERC grant holders. The Computational Sciences team is involved in 5 European projects and has produced 58 patents.

The Computational Sciences RD comprises 4 Priorities.

- The Development HPC Algorithms & Software Priority will build computational infrastructure and internal skills in algorithm and software development, focusing on TT and applications.
- The Computational Modelling Priority will involve curiosity-driven research with the transversal application of advanced theoretical methods to problems generated by other RDs, including materials design, molecular dynamics, and computational chemistry.
- The other Priorities (Machine Learning and Artificial Intelligence, and Computer Vision) will develop their own basic research, while supporting the activity of the Robotics, Nanomaterials, and LifeTech RDs. The transversal impact of the Computational Sciences RD on all of IIT's scientific activities is a major asset for IIT's research.

#### *2.2.4 Participant 4 – Centro Internazionale in Monitoraggio Ambientale - Fondazione CIMA: HUB Founder and affiliated to SPOKE 3*

CIMA will participate in Spoke 3 with a team which represents an excellent combination of atmosphere physicists, hydrologists, and research technicians with a pluri-annual expertise on the modelling and monitoring of hydro-meteorological processes at high-spatio temporal resolution on spatial and temporal scales ranging from the very short range (less than six hours) to climate scale range passing through short-range one (up to 48 hours). The overall team expertise integrates basic research on atmosphere dynamics with the operational aspects of high-resolution weather forecasting, including the data assimilation of observations collected from meteorological stations, lightning sensors, global navigation satellite system (GNSS), radar and satellites, as well as to study future scenarios that take climate change into account. The team is also specialized in floods forecasting, water resources management and thematic maps creation with focus on hydrological and hydraulics modelling, the use of satellite data to drive and correct model's predictions, the mapping of hydraulic risk, and the impact of climate change on the hydrological extremes. The team has been developing a set of research and operational services by combining HPC, Cloud and Big Data to improve the prediction of hydro-meteorological phenomena of interest for Civil Protection, agriculture, air pollution, renewable energy, water cycle and coupled air-sea applications. Team members are also adjunct professor at the university of Genoa, speakers at international training school and part of the board of PhD programmes. The team has coordinated/contributed to various FP7, H2020, ESA projects and to the Emergency Response Coordination Centre (ERCC).

#### Collaborations

CIMA team members have developed important national and international collaborations with universities, research centres and policy stakeholders. These collaborations include (but are not limited to): 1) Leibniz Supercomputing Centre (LRZ); Focal point: Professor Dieter Kranzmueller, topics: e-infrastructures, high performance computing and cloud computing for weather modelling; 2) Institute for Applied Mathematics and Information Technologies of the Italian National Research Council (IMATI-CNR); Focal point: Prof. Andrea Clematis; topics: e-infrastructures, high performance computing and cloud computing for weather modelling; 3) European Centre for Medium Range Weather and Forecasts (ECMWF); Focal point: Florian Pappenberger; topics: weather forecasting, big data management; 4) University of Milan-Bicocca; Focal Point: Claudia Pasquero; topics: coupled air-sea processes, climate processes; 5) University of Bologna; Focal point: Silvana Di Sabatino; topics: climate change, citizen science, urban weather and climate processes; 6) European Space Agency; Focal point: Bjorn Rommen; topics: earth observation data for severe hydro-meteorological data prediction; 7) Iowa State University; Focal point: Bill Gallus; topics: climate change and severe rainfall events; 8) Geomatics Research & Development (GR&D) S.r.l.; Focal point: Eugenio Realini; topics: GNSS for weather processes monitoring and modelling; 9) Duferco Participations Holding SA; Focal point: Lorenzo

Pittaluga; topics: weather forecast for renewable energy production prediction 10) Various United Nations Agencies. Several research projects have been funded on the previous topics by EU (Interreg, FP7, H2020), ESA and several other Funding Agencies.

### *2.2.5 Participant 5 – Engineering Ingegneria Informatica S.p.A.: affiliated to SPOKE 1, 2 and 4*

EII is a Digital Transformation Company, leader in Italy and expanding its global footprint, with around 12,000 associates, with over 40 offices spread across Europe, the United States and South America and global delivery. EII consisting of over 20 companies in 12 countries, has been supporting the continuous evolution of companies and organizations for more than 40 years, with a diversified portfolio built around proprietary solutions, best-of-breed market solutions, and managed services. The 40+ years presence in all market segments (Finance, Healthcare, Agrifood, Utilities, Manufacturing, Retail, Public Administration, Transport, Security, Defence, Space) has allowed EII to build deep knowledge of business needs and anticipate them by exploring constantly the evolution of technologies.

#### Previous Experiences and Scientific Competences

The R&I division, with over 450 researchers and data scientists (and a global innovation network of universities, start-ups, and research firms), invests in international R&D projects while exploring ground-breaking technologies and developing new business solutions. The R&I division is organised in Labs addressing the following application-oriented topics: Industry4.0, Smart Agrifood, Physical and Cyber Security, Defence, e-Health, Smart Cities, Innovation in Public Administration and Services, Energy, Cultural Heritage, Media and Telco. The R&I division is also engaged in technology-oriented topics, such as Cloud Computing, Internet of Things (IoT), Big Data, Artificial Intelligence, Distributed Ledger Technology, Semantics Technology, Natural Language Processing, Robotics. For the last 10 years, more than 200 research projects have been run by EII. Among them, 138 are in the Horizon 2020 EU Programme (31 of them have been coordinated by EII), with a total received funding of about 62M. More than 40 projects in the last years are in the domains that are relevant for the Spokes of interest. R&I division has produced about 160 scientific publications over the last 10 years in addition to many prototypes (more than 200) that have been delivered in the context of the research projects. Several of them have been adopted, evolved and further exploited by the Business Units in commercial projects.

#### Relevant Research Projects

**ACTIVE (EIT Digital):** The objective of the project is the development of an advanced connectivity platform (ACTIVE), which offers a unified approach consisting of end-to-end components and solutions enabling the development of applications and services for different vertical segments in the IoT domain. EII is responsible of a case-study concerning the development of a solution, built atop the ACTIVE platform, for the assistance to elderly patients with high-risk of fall. Such solution is based on a network of heterogeneous devices, including a robotic rollator (designed and developed by EII) equipped with ad-hoc developed sensors and actuators.

**AMICO (PON MIUR):** This project aims to create an infrastructure, called "instrumented environment", consisting of both the home environment and of the person, both suitably equipped with sensors, a telemedicine service platform (on the Internet of Things) and a Robot who acts as a mediator / master between the person, the surrounding environment and the external environment. This infrastructure, oriented to the citizen's well-being, can offer both services oriented to the person in his home environment, monitoring their behaviour and psycho-physical state, and telemedicine services to support the remote monitoring of citizens affected by a cardiovascular event undergoing rehabilitation therapies from part of doctors or caregivers.

**SUMMIT** The goal of SUMMIT (MISE-H2020 – Italian project) was to design and build a configurable, extensible and adaptive IoT platform enabling secure and dependable integration and management of smart objects. Among its outcomes, SUMMIT delivered an environment to design, emulate, execute, monitor and control distributed software systems based on IoT, embracing the Digital Twin paradigm. The platform was validated through relevant use cases in Smart Building, Smart Health e Smart Manufacturing domains.

**URBANAGE** - Enhanced URBAN planning for age-friendly cities (H2020-DT-Transformations-02; 2021-2024). URBANAGE aims at assessing the potential benefits, risks, impact of implementing a long-term sustainable framework for data-driven decision-making in the field of urban planning for age-friendly cities, using an inclusive co-creation strategy with relevant stakeholders (public servants and older adults) and disruptive technologies such as urban Digital Twins, big data analytics, AI. <https://www.urbanage.eu/>

URBANITE - Supporting the decision-making in URBAN transformation with the use of disruptive Technologies (H2020-DT-Transformations02; 2020-2023). URBANITE will analyse the impact, trust, attitudes of civil servants, citizens and other stakeholders on the integration of disruptive technologies (AI, DSS, big data analytics and predictive algorithms) in data-driven decision-making processes in the urban transformation field and validate its results by piloting mobility use-cases. <https://urbanite-project.eu/>

DECIDO - evidence and Cloud for more Informed and effective policies (H2020-DT-GOVERNANCE-12; 2021-2024). DECIDO enables PA to take full advantage of shared data, analytical tools/methodologies, computational power, cloud services and co-creation for the development of better targeted and more effective evidence-based policies, leveraging on the capabilities and services offered by the European Open Science Cloud (EOSC). <https://www.decido-project.eu/>

SPOTTED - Satellite oPen data fOr smarT ciTy sERVICES Development (CEF-TC-2020-2 Public Open Data; 2021-2024). SPOTTED aims to improve the current services and foster novel applications based on Open Data and technologies such as Earth Observation, AI, Cloud, Big Data. An innovative high-performance data infrastructure to enable automated collection, combination, management, processing, enrichment, securing & privacy preserving of heterogeneous datasets to support decision makers in Green Areas management

ANDROMEDA - The project aims to unlock the full potential of the EU Common Information Sharing Environment (CISE), by validating in a long period of time CISE-compatible command, control and coordination systems from several Coast and Border Agencies.

### Digitalization Initiatives

Digital Enabler, as an “Ecosystem” platform, it enables new data economy business models, fostering innovation & enhancing current capabilities. It allows you to Harmonize, Integrate, Visualize, Mashup, Analyse data to power digital transformation processes. The Digital Enabler was defined and developed in Smart City related innovation projects (funded by EIT Digital) and then evolved and applied in different domains in collaboration with the Business Units of EII (<https://www.eng.it/en/our-platforms-solutions/digital-enabler>).

SELECT for Cities (Pre-Commercial Procurement; 2017-2019). The project aimed to deliver open, standardized, data-driven, service-oriented and user-centric platforms for European cities to enable large scale co-creation, testing and validation of urban IoE applications and services. EII was lead contractor of one of three Consortia that reached and successfully completed the third phase of the project (the Living Lab), testing its digital platform in real life in Antwerp & Helsinki. <http://www.select4cities.eu/>

Diomedee project. It is a telemonitoring and telemedicine solution against the Covid emergency. It was set up to digitise the care of specific chronic conditions (e.g., heart failure, diabetes, hypertension) and their remote assistance, has been expanded and reconfigured to meet the need to monitor Covid-19 patients, optimizing available resources and limiting physical access to healthcare facilities.

The adoption at the ULSS 6 Euganea, an avant-garde hospital at Italian and European level made up of 7 hospitals distributed in the Province of Padova and serving more than 900,000 inhabitants in the area, of our new ICU-Medical Record. It is a next-generation solution that supports health professionals providing an intuitive, complete and safe way for the diagnosis, planning and execution of therapeutic procedures. Doctors and nurses in the care-intensive areas now have a real "digital assistant".

iCare Assistant, created by EII, represents a new experimental service model, the first of its kind in Italy, able to accompany the client throughout the journey from home to the clinic, also offering, within the Navile Healthcare Centre in Bologna, a new concept of “UltraLuogo”, through the consultation of augmented reality services useful to the user.

ALIDA: Big Data Analytics as a Service: Data Science and Machine Learning platform for rapid application prototyping and deployment, enabling and supporting augmented analytics and ML-Ops processes and practices.

### Participation in International Initiatives

EII actively participate in international initiatives aimed to foster innovation in different areas:

- Gaia-X: EII is a member in Gaia-x board of directors and participate to the following WGs: Federation Services, Architecture, Portfolio, X-Association, Provider;
- EIT Digital (European Institute of Innovation and Technology) where EII is a core partner;

- BDVA (Big Data Value Association)/DAIRO: EII is founding member, board of directors member, active participant in different working groups and leader of those in: Security, Smart City and Government, Energy and Smart Manufacturing Industry;
- FIWARE Foundation: EII is founding member, BoD Chair, active contributor of Generic Enablers, member of the Technical Steering Committee;
- International Data Space Association (IDSA): EII is board member.

Furthermore, the company is co-founder of the Big Data Value cPPP, co-founder of the European initiative Future Internet PPP, partner of the Alliance for the Internet of Things (AIOTI PPP), board member of the European Organisation for Security (EOS) and European Cyber Security Organisation (ECSO), and co-founder of NESSI (Networked European Software and Service Initiative). It is an active member of many international open-source communities and founder of SpagoWorld, a free/open-source initiative managed by EII. The company is member of OW2 Consortium and Eclipse Foundation. It is also collaborating with OASC (Open and Agile Smart Cities) and is supporting Living-in.eu movement.

### 2.2.6 Participant 6 - ETT S.p.A.: affiliated to SPOKE 1, 3 and 5

ETT, an international digital and creative industry, recorded a consolidated Group turnover of 28,5 million euros in 2021. ETT is a market leader in concept creation and the management of Italian digital cultural heritage, the design of information systems for Smart Governance job markets, and integrated Smart City systems connecting cities, locations and people. ETT delivers digital solutions based on innovative technologies (Augmented Reality, Virtual Reality, mobile, IoT, AI, ML, data analysis, geo-located data, etc.) in the following key areas: Innovative ICT systems for immersive and engaging user-experiences in Cultural Heritage, Tourism, Training and Education; Smart cities: geo-located systems and Big Data analysis for environmental, climate and energy monitoring; Life sciences: smart health systems, digital therapeutics, serious gaming, cognitive training.

ETT is a proactive partner for Research Organisms and, besides working together on R&D projects, it provides the RO with support for education and training activities such as hosting of industrial thesis, traineeships, industrial PhD programs, etc. ETT believes in these joint educational activities that provide talented students with soft-holistic skills to be preferred candidates its future open positions.

Spoke 1 related main projects: NUB – New Urban Body Esperienze di generazione urbana [Fondazione Husing Sociale, 2018-2019]; SMART&Touch-ID - SMART&Touch-ID: l'HUB per la creazione di sistemi riabilitativi innovativi-SMART, connessi a bisogni e territorio-Touch, individualizzati-ID e sostenibili [POR FESR LOMBARDIA 2014-2020]; Relater - Realizzazione di un dispositivo di Realtà Aumentata dedicato alla riproduzione delle alterazioni delle capacità visive a supporto della riabilitazione visive [POR FESR LIGURIA 2014-2020]; VR per la simulazione del comportamento in scenari interattivi di vita quotidiana [Regione Molise, 2018-2019]; Ai Memo - Alzheimer Early Monitoring [POR FESR LIGURIA 2014-2020]; Laboratori Aperti dell'Emilia Romagna - Ferrara, Ravenna, Modena, Forlì [POR FESR EMILIA ROMAGNA 2014-2020]; Smart Angel – Piattaforma cloud mobile a sostegno dell'autonomia dei disabili cognitive [POR FESR LIGURIA 2007-2013]; ACIRAS - Ausili Cibernetici Riabilitativi per la diagnosi e la valutazione quantitativa della disabilità motoria dell'Arto Superiore nei bambini e negli adulti [POR FESR LIGURIA 207-2023]; King's College London - Serious Game per uno studio sull'infanzia e l'adolescenza [King's College London. 2015]

Spoke 3 related main projects: EMODnet (European Monitoring Observation Data network) – Physics [European Commission - DG MARE, 2010-2024]; Copernicus Marine Service – Dissemination Unit/Marine Data Store [European Commission, 2018-2023]; Nautilus - New Approach to Underwater Technologies for Innovative, Low-cost Ocean observation [European Commission – H2020 – BG-07-2019-2020 – IA-LS, 2020-2024]; SO-CHIC - Southern Ocean Carbon and Heat Impact on Climate [European Commission - H2020 LC CLA 08-2018 – RIA, 2019-2023]; SeaDataCloud - Further developing the pan-European infrastructure for marine and ocean data management [European Commission – H2020-INFRAIA-2016-2017-RIA, 2016-2020]; SENTINEL – Sistema di pEsatura diNamica inTelligente per la gestioNE deL traffico pesante [MUR – PON Ricerca & Innovazione 2014-2020, 2018-2022]; GRISISs - Gestione dei Rischi e Sicurezza delle Infrastrutture a Scala Regionale [POR FESR CAMPANIA 2014-2020]; PLANNER - Piattaforma per LA GestioNe dei rischi Naturali in ambiEnti uRbanizzati [POR FESR CAMPANIA 2014-2020]; Smart CASE Soluzioni innovative MultifunzionAli peR l'otTimizzazione dei Consumi di energiA primaria della vivibilità indoor nel Sistema Edilizio [MUR – PON Ricerca & Competitività 2007-2013]; CREEM – Control Room per l'Efficienza Energetica e Manutentiva [POR FESR SICILIA 2007-2013]

With regard to Spoke 5, ETT will provide consultancy for the design of a smart reactive environment in the area under San Giorgio's bridge.

It will consist of a physical place that will be used for displaying innovative technologies (AI and Robotics) and for co-designing the experimentation, project management and co-creation, together with other researchers, of this physical place.

This environment will also be a reference point to show how new technologies, in the near future, can be integrated into the environment and everyday life.

<https://ettsolutions.com/> <https://www.youtube.com/user/ettsrl>

**Spoke 5 related main projects:** 7 passi nella Sostenibilità, Allestimento Multimediale e Interattivo [Città della Scienza, 2021], Oro di Montalcino - Tempio del Brunello, Allestimento Multimediale e Immersivo [Opera Laboratori, 2021]; Casa Museo Pirandello, Allestimento Multimediale e Immersivo [Regione Siciliana, 2021]; Museo Casa Dante, Allestimento Multimediale e Immersivo [Unione Fiorentina Museo Casa di Dante, 2020], La Divina Commedia VR: l'Inferno, un viaggio immersivo [ETT, 2021]; MIA AVELLA, Allestimento Multimediale e immersivo [Museo Immersivo e Archeologico di Avella, 2021]; Casanova Museum & Experience [Fondazione Casanova, 2019]; Ars Excavandi, Allestimento Multimediale e Immersivo [Fondazione Matera – Matera Capitale Europea della Cultura 2019]

### 2.2.7 Participant 7 - Leonardo S.p.A.: affiliated to SPOKE 3 and 4

**Leonardo is a global high-tech company**, delivering advanced solutions based on dual use technologies, to meet both military requirements and civil applications. As an industrial and technological leader, the Company aims at being an engine for development, contributing to security and progress worldwide. Headquartered in Italy, Leonardo operates globally, through a deep-rooted industrial presence in four domestic markets (Italy, United Kingdom, United States and Poland), backed by an international commercial network and a number of representative offices, subsidiaries and joint ventures with an overall presence in 46 countries worldwide.

**Leonardo key figures:** (i) total workforce – 49,992 (31,000 in Italy); (ii) revenues in 2020 - 13.4 B€; (iii) R&D in 2020- 1.6B€; (iv) 2nd place in Europe and 4th place in the world for investments in R&D in the AD&S sector in 2020; (v) 8,800 people involved in R&D and engineering.

**Participation to RAISE will involve mainly R&D and Engineering areas of the Leonardo Cyber Security Division**, that delivers Secure Digital Solutions to protect institutions, enterprises and citizens, guaranteeing the resilience of strategic assets through secure digitalisation of processes, infrastructure and applications, while constantly monitoring and responding to both physical and cyber threats.

Leonardo Sent the CVs of 7 researchers belonging to the company and matching the activities of the Program and Spoke 4, of which at least 4 for 3 months / person / year. During the implementation phase, Leonardo will select the most appropriate professionals, including the possible use of researchers with fixed-term contracts.

**Experience in R&D and Applied Innovation:** Leonardo's Cyber Security Division whose primary site is in Genoa, has a proven experience in conducting research, innovation and technology transfer projects, and has currently conducted over 30 R&D projects (National, European, EDF, Regional, Military) in the last 5 years.

Projects completed or underway include SECUREGAS (security of 140.000Km of the European Gas network covering the entire value chain from Production to Distribution), RESISTO (comprehensive solution that allows cybersecurity of Communication Infrastructure and joint understanding of cascading effects across interconnected CIs), ATENA (OT/IT security convergence protecting the value chain by cyber intelligence proactive security) and SPARTA (Pilot Project for the implementation of European Network of Security Competence Centres). The division is also active in projects with Regional scope like ITER (Security of the Energy Infrastructure of the La Spezia Naval Base), Genova 5G (5G applications for advanced Transport Solutions).

Leonardo is a founding partner of Ligurian “Distretti Tecnologici” (SIIT- Sistemi Intelligenti Integrati) and Competence Center (Start 4.0).

In relation to the specific Spoke 4, Leonardo boasts also a vertical experience on topics related to Logistics and Safety in the Maritime field, further increased following the incorporation of Vitrociset SpA into Leonardo. In particular Leonardo managed the implementation and management of the security systems at the port gates of the AdSP (Autorità di Sistema Portuale) Western Ligurian Sea, Eastern Ligurian Sea Eastern Adriatic Sea, Northern Adriatic Sea as well as

projects that insist on the technologies covered by the Spoke on the management and integration of data between port stakeholders.

In term Physical and Logical security Leonardo has more than 25 years' experience working for international (ESA, MoD, NATO) and civil sector (critical infrastructure, transport, banks, civil protection, ports) and the management of public services. The Division has approximately 1500 employees with specific skills in ICT and Security.

**Main Topic of Interests and Activities:** Leonardo will participate to the activities of Spoke 4 contributing to SL1, topic 1.4: Automation of physical and virtual gates for vehicle and people check-in, and robotization of industrial equipment (IIT, UniGe), with specific reference to gates. Within this area Leonardo already operates with AdSP West Ligurian Sea and therefore a natural integration of new technologically advanced initiatives with the ongoing activities is possible.

Leonardo will also contribute to SL2, topic 2.5 (Port protection and cybersecurity) with initiatives regarding Cybersecurity assessment, Risk Analysis, Advanced Threat Intelligence and/or Emulation of Port infrastructure for Training, Exercise and Validation. Concerning Physical Security Leonardo can contribute to the project with AI/Deep Learning technologies solutions and video analysis. Within this activities Leonardo can manage Proof of Concept of innovative Solutions, Experimentation of new technologies and solutions, Integration with SMEs with which Leonardo collaborates through cascade tenders.

### *2.2.8 Participant 8 - IRCCS Ospedale Policlinico San Martino: affiliated to SPOKE 1 and 2*

HSM has always been a health landmark. With its five centuries of history, it is the main “health hub” not only for local people, attracting patients from the metropolitan area and from all over Liguria, but also from outside the Region.

After the merging of the San Martino University Hospital and the Scientific Institute for Cancer Research, the “IRCCS San Martino Hospital – IST National Cancer Research Institute” was established on September 1st, 2011, with a particular focus on haematology and oncology.

At the end of 2017, the name of the Institute was changed to “IRCCS Policlinico San Martino Hospital”. On May 3rd, 2018 the Institute was certified for specialization in Neuroscience.

The Institute hosts the educational pole of the School of Medical and Pharmaceutical Sciences which includes the Degree Course in Medicine and Surgery, Specialization Diplomas, PhD, first and second level Master Courses and Degree Courses in health professions.

The Institute provides healthcare services for the diagnosis and treatment of illnesses in in-patient and out-patient settings. In addition to being a general hospital, HSM is a leading institution in the field of research, diagnosis and treatment of neurological and psychiatric disorders of adulthood including immune-mediated diseases of the central and peripheral nervous system such as multiple sclerosis, neurodegenerative diseases such as Alzheimer and Parkinson disease, neuromuscular diseases, including genetically determined neuropathies, stroke, diseases linked to altered synaptic transmission, gliomas and psychiatric diseases. Another area of interest focuses on changes of neural plasticity under pathological conditions and upon neurorehabilitation treatments.

Specific research lines focused on psychiatry, neurorehabilitation, multiple sclerosis, Parkinson disease, Alzheimer and visual impairments are carried on at HSM. Scientists working in these research areas have been funded by National, European and international funding bodies.

Related to psychiatry, the major research topic is the study on affective disorders (depression and bipolar disorders) and schizophrenia (from early onset to chronic patients) by means of functional and structural neuroimaging techniques in MRI, and psychometric, neuroradiological and bio humoral assessments are carried on.

Concerning neurorehabilitation, the major research topic is the study on neurorehabilitation of stroke and neurodegenerative diseases with neurophysiological techniques such as transcranial magnetic stimulation and EMG and novel technologies for the implementation of home-based rehabilitation.

Related to Parkinson's disease, research is focused on the study of pathophysiological mechanisms and the treatment of symptoms poorly responsive to pharmacological treatment by using non-invasive brain stimulation, hdEEG, gait and balance analysis through a Motion Capture System.

Concerning Alzheimer's dementia, the major research is the study of clinical and diagnostic application of advanced neuroimaging and nuclear medicine techniques in degenerative dementias such as Lewy Body Dementia or Alzheimer's Dementia.

Multiple sclerosis (MS)'s research is focused on the study of clinical and diagnostic application of advanced neuroimaging in the disease: quantitative approaches have been validated to study the topological properties and distribution of damage in cognitive networks and correlation of clinical data between MS and early sensory damage in the lower limbs have been demonstrated.

Finally, regarding visual impairments, neuroinflammation and Molecular mechanisms are studied in different visual disturbances including Primary Open-Angle Glaucoma.

HSM is also a leading institution in the field of research, diagnosis and treatment of cardiovascular diseases in adults and particularly in the following fields: Cardiology (Acute treatment of myocardial infarction, acute heart failure and cardiogenic shock. Regional reference centre for TAVI, structural heart diseases and percutaneous revascularization with circulatory support. Screening and management of inherited cardiomyopathies. Cardio-oncology; Cardiac surgery (Mini-invasive cardiac surgery and “beating-heart” surgery for coronary arteries and valves; LVAD implant as “destination therapy” or as a “bridge” to cardiac transplant; veno-venous or veno-arterial ECMO. Hub centre for all the circulatory support devices); Vascular surgery (open, endovascular and hybrid treatment for complex thoracic, thoracoabdominal and abdominal aorta pathology (aneurysm and dissections), treatment of peripheral artery and carotid disease, evaluation of local and systemic inflammatory profile for atherosclerosis, screening program for aortic aneurysm).

In addition to the offer in all major surgical medical services, Policlinico San Martino is at the forefront in the diagnosis and treatment of major haemato-oncological diseases, with a range of activities ranging from acute leukaemia to marrow transplants, to solid tumours classified as "big-killers". The large cohort of patients allows clinical studies on chemotherapy drugs and also on new molecular targets. Moreover, because of the numerous case studies, translational studies on "mechanisms of carcinogenesis and neoplastic growth" are possible on biological material coming from patients, investigated “in vitro” in laboratories equipped with the most modern technologies.

The Institute has specific research facilities such a dedicated grant office, a clinical trial office and several core facilities including an animal facility, a Biological Resource Centre (CRB-HSM), repository of cancer and neural specimen, pathology, genomic, proteomic, cytomic and imaging (for humans and small animals) facilities and the recently established Life Science Computational Lab for AI-based analysis and interpretation of the data generated within the hospital campus. Research laboratories are located in the 4 towers building IST Nord (previously known as Advanced Biotechnology Centre).

The Institute has some partnerships with private companies as an example: Bio4Dreams (Technology Transfer) Tib-Molbiol, Active Cells S.r.l, Siemens ASG, Superconductors, 3Brain and Moretti Consulting.

### *2.2.9 Participant 9 - Istituto Giannina Gaslini: affiliated to SPOKE 1 and 2*

It is a National Public Children's Hospital and Research Institute located in Genoa, Italy. It is the only one in Italy in the maternal-children sector. Moreover, from July 1, 2022, by regional regulation, Gaslini will assume the role of HUB for all paediatric wards in Liguria.

It is a multidisciplinary, highly specialized reference centre with national and international catchment area. It is the only hospital in Italy providing specialist and sub-specialist care, both medical and surgical, for mothers and children. Therefore, it is a national referral centre for complex diseases affecting new-borns, children, and adolescents requiring highly specialized treatment.

The hospital staff members are over 1,800, including 270 physicians and 850 nurses. Beds available for ward hospitalization, for day hospital admissions and for day surgery are over 300. On average, hospitalizations are over 30,000/year and outpatient admissions over 540,000/year. Emergency Dept. admissions are over 33,000/year.

More than 42% of patients come from all regions of Italy, mainly Sicily, Piedmont, Apulia, Campania, Lombardy, and Tuscany. Annually, 4,4% of patients come from abroad.

Gaslini hosts facilities and staff of the University of Genoa under a formal agreement. Degree courses in Medicine and Surgery are held at Gaslini, and residency programs in paediatrics, neuropsychiatry, and paediatric surgery are also carried out.

In 2020, Gaslini won as a coordinating centre or as a partner 20 national research grants and 6 international research grants, totalling more than 6 million euros.

During 2020, 3 Gaslini patents were extended internationally, 2 with Patent Corporation Treaty and one in the US. The adoption of 2 new patents is underway.

The whole hospital staff contributes to the development of research programmes that are grouped into 5 lines, namely: innovative diagnostic-therapeutic strategies and rare diseases; paediatric sciences, surgery, and neonatology; rheumatology, immunology, and autoinflammatory diseases; haematology, oncology, and cell therapies; muscular and neurologic diseases.

The Gaslini is part of several national or regional networks (IDEA, RIN, ACC, Cardiology Network, RAMS, INCIPITR Consortium, A IATRIS Association, EATRIS ERIC Consortium, ONLUS IMAGO 7 Research Foundation, Ligurian Life Sciences Pole Association) confirmed in 2020, which involve the main Italian clinical and research centres and are mostly promoted by the Ministry of Health. In addition, the Gaslini is actively involved in the following 13 European Reference Networks (ERNs): ERN BOND (European Reference Network on Rare Bone Disorders), ERKNet (European Rare Kidney Diseases Reference Network), EuroBloodNet (European Reference Network on Rare Hematological Diseases), EURO-NMD (European Reference Network for Rare Neuromuscular Diseases), MetabERN (European Reference Network for Rare Hereditary Metabolic Disorders), PaedCan-ERN (European Reference Network for Paediatric Cancer, haemato-oncology), RITA (Rare Immunodeficiency, Autoinflammatory and Autoimmune Diseases Network), EPICARE (European Reference Network on Rare and Complex Epilepsies), ERNICA (European Reference Network on Rare Inherited and Congenital Anomalies), ERN ITHACA (European Reference Network on Intellectual Disability, TeleHealth, Autism and Congenital Anomalies), ERN LUNG (European Reference Network on Respiratory Diseases), VASCERN (European Reference Network on Rare Multisystemic vascular Diseases) and ENDO ERN (European Reference Network on Rare Endocrine Conditions).

The Trial Centre relies also on an internal academic facility that assists the pharmaceutical industry in evaluating the efficacy and tolerability of new pharmacological molecules and related outcome measurements. Particularly well developed in the rheumatology field it has already managed all the major international multicentre trials that have allowed the registration of new biological drugs used today for the treatment of rheumatic diseases in children. It manages the data management of over 40,000 children with rheumatic diseases worldwide.

In its Strategic Plan the transformation of the hospital into a City of Health is foreseen, with the construction of a pavilion for high complexity and high intensity of care and the re-functionalization of 5 buildings for complementary functions of social and socio-healthcare value: the new structure can form the basis for living labs for paediatric needs for spoke 1 and spoke 2.

For its triple nature, moreover, the Institute is interested in applying to create value in terms of care, research, training.

In terms of research, the company is interested in initiating co-design processes in which its multidisciplinary and multi-sector competencies can be put to good use for the improvement of care. In this sense, the Institute's strategic plan includes both Telemedicine and the secondary use of data through the domain expertise that the Institute can express in many paediatric specialist disciplines.

In terms of training, in addition to being the seat of training activities for paediatrics and surgery (as well as for other health professions) it is interested in exercising a role of strategic patronage in terms of industrial doctorates as a research pole within which operate, in addition to clinicians, also new skills (biostatisticians, bioinformaticians, data managers, visual data managers etc.) for which it is necessary to provide actions of increase and turnover.

Finally, the Institute is interested in strengthening the activity of TTO thanks to the skills that will be made available by the HUB of services.

Gaslini can contribute to the project from different points of view:

- Clinical competence for Telemedicine pilot projects and for the secondary use of data;
- Design and validation of personalized monitoring, assistance and rehabilitation programs for specific pathologies;
- Design and validation of prostheses and new devices for surgery or endoscopy and related testing of prototypes based on emerging needs in the paediatric and foetal fields.
- Design and validation of neuroradiological and neurophysiological monitoring systems
- early diagnosis and rehabilitation in autism spectrum disorder by means of Artificial Intelligence programs and robotic devices.
- Promotion and hosting of Innovation Lab

## 2.2.10 Participant 10 - algoWatt S.p.A.: affiliated to SPOKE 3 and 4

algoWatt ([www.algowatt.com](http://www.algowatt.com), listed on the Euronext Milan market of Borsa Italiana S.p.A.), a green tech solutions company, designs, develops and integrates solutions for the management of energy and natural resources in a sustainable and socially responsible manner. The company provides management and control systems that integrate devices, networks, software and services with a strong focus on digital energy & sustainable transports. algoWatt was born from the merger of TerniEnergia, a leading company in the renewable energy and environmental industry, and Softeco, an ICT solutions provider with over 40 years of experience for customers operating in the energy, industry and transport sectors. The company, with over 200 employees in 7 locations in Italy and investments in research and innovation amounting to over 12% of its turnover, operates with an efficient corporate organisation focused on its reference markets: Green Energy Utility: renewable energies, digital energy, smart grids; Green Enterprise & City: IoT, data analysis, energy efficiency, building and process automation; Green Mobility: electric, in sharing and on demand.

With its dedicated R&I division, algoWatt participates in technological innovation projects and initiatives at European, national and regional level through numerous scientific and technological collaborations that represent for the company the keys to the development of high-tech products. Overall, since 1993, algoWatt has participated as coordinator or partner in over 100 research and innovation projects in various application areas (transport, energy and environment, ICT, etc.), strategically exploiting its network of international contacts and numerous affiliations at regional and national level:

- algoWatt is a member of START4.0 ([www.start4-0.it](http://www.start4-0.it)), the Italian Centre of Competence for the safety and optimisation of strategic infrastructures, including energy infrastructures/electricity grids.
- algoWatt is a member of Siit ScpA ([www.siitscpa.it](http://www.siitscpa.it)), a non-profit consortium representing a regional territorial aggregation, whose main purpose is to promote and foster the competitiveness of productive areas and sectors of interest in the territory.
- algoWatt is a member of Genova Smart City ([www.genovasmartcity.it](http://www.genovasmartcity.it)), an association coordinated by the Municipality of Genoa that aims to develop sustainable projects for the city.
- algoWatt is a member of Poli Regionali Ligurali di Ricerca e Innovazione EASS - Energia, Ambiente, Sviluppo Sostenibili ([www.poloeass.ticass.it](http://www.poloeass.ticass.it)), TRANSIT - Tecnologie e Ricerca, Network, Sicurezza ed Intermodalità nei Trasporti ([www.polotransit.siitscpa.it](http://www.polotransit.siitscpa.it)) and PLSV - Polo Ligure Scienze della Vita ([www.poloplsv.liguriadigitale.it](http://www.poloplsv.liguriadigitale.it)).
- algoWatt is member of Etna HiTech ([www.etnahitech.com](http://www.etnahitech.com)), a stable consortium of companies operating as general contractor in private sector contracts and as SME in research and development activities in large industrial research and experimental development projects with Universities and Research Institutes.
- algoWatt is a research partner of the Energy & Strategy Group ([www.energystategy.it](http://www.energystategy.it)), a national reference point for understanding competitive dynamics in the renewable energy sector in Italy, analysing and interpreting company strategies, technological choices and competitive dynamics.
- algoWatt is a member of CEI (Comitato Elettrotecnico Italiano) and participates in the technical committees IEC CEI TC57 Working Group WG3 (Telecontrol Protocols) and IEC TC57 Working Group WG15 (Data and Communication Security), contributing to the Technical Specification IEC 62351-100-1 "Conformance Testing of IEC 62351-5 and its derivatives" and IEC 60870-5-7 "Telecontrol equipment and systems - Part 5-7: Transmission protocols - Safety extensions to IEC 60870-5-101 and IEC 60870-5-104 protocols (application of IEC 62351)".
- algoWatt is a member of the TTS Association ([www.ttsitalia.it](http://www.ttsitalia.it)), National Association for Telematics for Transport and Safety, which aims to contribute to the improvement of the efficiency and safety of the Italian transport system.

As regards the membership as an affiliate of SPOKE 3 "Sustainable Environmental Caring and Protection Technologies", algoWatt brings to the ecosystem its proven experience in the design, management and implementation of complex projects with a strong connotation of technology transfer and digital transformation in the sectors of interest, energy and transport. Many years of experience in these contexts, characterized by high complexity and a high degree of innovation, have enabled algoWatt to develop, refine and promote a portfolio of technical skills and high-profile technological solutions with high potential for commercial exploitation. Among the many initiatives, the following projects deserve special mention:

- SMARTGEN (CCSE - Electricity System Research): study, development and validation of innovative methods and tools for the management of active distribution networks with generation from renewable sources.

- ILLUMINATE (FP7 ICT PSP G.A.297227), first European project of the Genova Smart City framework: innovative solutions (both for energy efficiency and lighting quality) for the applicability of Solid-State Lighting (SSL) technology in valuable urban areas and buildings of public interest.
- RESTABILISE4.0 (Call 1 - START4.0): development, integration and validation on a real microgrid of a toolkit to manage and ensure the resilience and reliability of energy systems.
- SAMPLE (Call for proposals 2 - START4.0): study, development and validation of a solution for the management and resilience of critical infrastructures dedicated to energy production from Non-Programmable Renewable Sources (FRNP), with particular reference to PV generation.
- CREEM (POR FESR Sicilia 2007-2013): study of a decision support system to improve the management techniques of energy services and maintenance of Italian Post Office branch buildings.
- PODCAST (CSEA - Ricerca di Sistema): study, development and validation of innovative operational tools for the exploitation of monitoring data of distribution networks (in particular smart metering, status estimation with direct and pseudo-measures).
- PICK-UP (POR FESR Liguria 2014-2020): study and development of methods, models and technologies integrating different interconnected and complementary aspects related to energy and sustainability (energy efficiency, active demand management, production from renewable and distributed sources, distribution and storage, sustainability models and environmental data).
- VPP4ISLANDS (H2020): solutions based on the digital twin concept, virtual energy storage systems and Distributed Ledger Technology to revolutionise VPP management and build smart energy communities on islands.
- VIRTUS (CSEA - Ricerca di Sistema Elettrico): VIRTUAL management of distributed energy resources and prototype implementation of a VPP (Virtual Power Plant) in an industrial tertiary context, also with reference to Energy Communities.
- ER4SMUS (MiSE): ICT platform for the optimised management of industrial production that combines the exploitation of "embodied energy" as energy storage aimed at energy saving and the active participation of the company in the energy system.
- E-SCALE (POR FESR Lazio): complete management service for aggregates of generation and/or consumption resources of the electricity system (DEMAND-RESPONSE-AS-A-SERVICE).
- SIMONE (Integrated System for the Monitoring of Electricity Production, POR FESR Sicily 2007-2013) studies and develops innovative solutions to address the challenges of active distribution networks by making energy supply more flexible and efficient,
- PASCAL (POR FESR 2014/2020 - Sicily): technological platform to respond to the needs of the Aggregator in the electricity market and for the Demand Response function by offering solutions from a technological and economic point of view.
- MYPASS (MiUR): development of actions for the diffusion of the MaaS model in Italy through i) measures, organisational scenarios, operational and business models that create the conditions for the development of MaaS; ii) innovative SW components that allow a significant increase in MaaS support technologies, improving interoperability and integration of transport systems in the ITS panorama.
- GETUP (POR FESR Liguria): study, prototype development and experimental validation in the Genoa area of a technological solution for Mobility-as-a-Service (MaaS).
- IMOVE (H2020): experimentation and validation of the Mobility-as-a-Service (MaaS) model with the implementation of pilot projects in several European cities and regions.

From the research carried out in cooperation with GRED a spin-off of Polytechnic of Milan. AlgoWatt developed GeoGuard is an innovative end-to-end GNSS service for continuous monitoring of structures and ground deformation. GeoGuard service includes hardware and activities specifically designed for monitoring the displacements and deformations of structures and ground on selected points, customized to different application scenarios, by means of accurate price-competitive GNSS positioning with centimetre-level accuracy in near real-time, or millimetre-level accuracy for daily/sub-daily solutions.

### *2.2.11 Participant 11 - Fondazione Don Carlo Gnocchi Onlus: affiliated to SPOKE 1 and 2*

FDG is one of the largest private not for profit organisation in the field of rehabilitation in Italy. With more than 60 years of experience and twenty-eight centres, FDG has a leadership role in rehabilitation, assistance and clinical research activities at national and European level. The target clinical population, with an overall number of 3 million patient access per year, is mainly made of people with any kind of disability, especially on the neurological and neuromotor

side, from childhood to elderly. FDG also provides assistance and social care services to people with disabilities and frail elderly people through the integrated home-care services and a number of day-time centres.

FDG employs overall more than 5000 persons including researchers, medical, paramedical, technical and administrative personnel. Two centres of FDG (in Milan and Florence) are acknowledged as IRCCS (Clinical Research Institutes) by the Italian Ministry of Health. In the Liguria region FDG runs the rehabilitation center “Polo Riabilitativo del Levante Ligure” of La Spezia.

The general strategy of FDG is to deliver high-quality treatments of complex cases in the excellence centres and operate in a context of continuum of care and assistance after patient discharge, to enable and optimize independent life. For this purpose, FDG has an intense activity of clinical research and technology innovation – with a growing presence of innovative solutions such as rehabilitation robots and tele-rehabilitation systems - also in cooperation with other clinical and research centres and industrial partners, at international level.

#### Contribution to the RAISE innovation ecosystem

FDG will be involved in the spoke 1 – Urban Technologies for Inclusive Engagement – and 2 – Smart Devices and Technologies for Personal and Remote Healthcare – of the RAISE innovation ecosystem. For both spokes, FDG will contribute to the detection of unmet clinical, social and assistance needs of the end users, to the definition of functional and technical requirements for the technological solutions to be developed, to the testing phases of the prototypes in real-world settings, as well as to the processing and analysis of the results of the experimentations. Moreover, FDG will contribute to the dissemination and exploitation of project results through its network of rehabilitation and social care centres as well as through its participation in national and international networks such as the “rete IRCCS” on Ageing and the European Platform for Rehabilitation.

#### Competences and infrastructures relevant to spokes 1 and 2 of the RAISE ecosystem

For what concerns the activities of spoke 1, FDG has solid competences in the assessment of needs of people with disability and elderly people and in the consequent definition of the most appropriate assistive solution to each individual need. In particular, FDG runs a network of services for the Information and Assessment on Assistive Technologies (the SIVA network – Servizi Informazione e Valutazione Ausili) located in 12 of its centres, including the “Polo Riabilitativo del Levante Ligure” of La Spezia. Moreover, the FDG centre IRCCS S. Maria Nascente of Milan also includes:

- The SIVALab service aimed at implementing innovative assistive technology solutions into the clinical and social services and spread the culture and knowledge of assistive technologies through dissemination activities.
- A Smart Home apartment infrastructured with home automation solutions for independence and care of people with disability. The smart home represents an ideal test bed for innovative solutions aimed at monitoring and assisting of frail people at home.
- Finally, through its Chronicity department, FDG also have solid competences in the assessment of cognitive decline and dementia and the consequent definition of the most appropriate approach for care and assistance, including therapeutic as well as tech-based strategies.
- For what concerns the activities of spoke 2, FDG has proven competences and instrumentations for the human movement analysis and the neurophysiological examinations including:
  - Optoelectronic instrumentation for motion capture
  - Inertial Measurement Units (IMU) for movement detection
  - Instrumentation for surface Electromyography (EMG)
  - Force platforms
  - Electroencephalography instrumentation (EEG)

In 11 of its centres, FDG has robotics solutions for the rehabilitation of upper and lower limbs. Overall, 43 robotic devices are present in the different centres (including the one of La Spezia) that automatically send the collected data to a central database. As of today, data of over 85000 robotic rehabilitation treatments administered to over 4500 patients have been collected in the central database.

Previous and ongoing projects and activities relevant to the spokes 1 and 2 of the RAISE ecosystem.

FDG has several collaborations currently active with IIT within the framework of the IIT-FDG JointLab established in 2017. In particular, the ongoing projects include:

The development and clinical validation of an exoskeleton robotic solution for the rehabilitation of post-stroke patients (ACTUAL project)

The development and testing of rehabilitation applications for the humanoid robot R1 of IIT (supported by the EC funded project ETAPAS)

The optimization of the MeCFES device for Functional Electrical Stimulation (FITFES project).

There are also a number of active collaborations with the UniGe (DINOEMI department) on the study of the physiopathology of Parkinson disease.

FDG participated into several EU funded collaborative projects on assistive solutions, rehabilitation robotics and solutions for monitoring patients. These includes among others:

- ETAPAS (<https://www.etapasproject.eu/>) Ethical Technology Adoption in Public Administration Services (H2020)
- ENRICHME (<https://cordis.europa.eu/project/id/643691>) Enabling Robot and assisted living environment for Independent Care and Health Monitoring of the Elderly (H2020).
- DECI (<https://cordis.europa.eu/project/id/643588>) Digital Environment for Cognitive Inclusion (H2020).
- CLOUD4ALL (<https://cordis.europa.eu/project/id/289016>) Cloud platforms Lead to Open and Universal access for people with Disabilities and for All (FP7)
- CYBERLEGS (<https://cordis.europa.eu/project/id/287894>) The CYBERnetic LowEr-Limb CoGnitive Ortho-prosthesis (FP7)
- CYBERLEGS Plus Plus (<https://cordis.europa.eu/project/id/731931>) The CYBERnetic LowEr-Limb CoGnitive Ortho-prosthesis Plus Plus (H2020)
- SRS (<https://cordis.europa.eu/project/id/247772>) Multi-Role Shadow Robotic System for Independent Living (FP7)
- ETNA (<https://cordis.europa.eu/project/id/270746>) European Thematic Network on Assistive Information and Communication Technologies (CIP)
- EASTIN-CL (<https://cordis.europa.eu/project/id/250432>) Crosslingual and multimodal Search in an Assistive Technology information portal (CIP)
- PerBrain - (<https://erapermed.isciii.es/wp-content/uploads/2020/02/NEWSLETTER-3-final.pdf> - p. 12) A Multimodal Approach to Personalized Tracking of Evolving State-Of-Consciousness in BrainInjured Patients (EraPerMED JTC2019)
- DoCMA (<https://cordis.europa.eu/project/id/778234/it>) - Disorders of Consciousness (DoC): enhancing the transfer of knowledge and professional skills on evidence-based interventions and validated technology for a better management of patients (H2020)
- COCARE (<http://www.aal-europe.eu/projects/cocare/>) - A Comprehensive Concept for healthy aging supported by digital solutions across the geriatric continuum-of-care (AAL 2019).
- AGAPE - Active aGeing And Personalised service's Ecosystem (AAL 2021)

### *2.2.12 Participant 12 - Aitek S.p.A.: affiliated to SPOKE 4*

Since 1986, Aitek is all about innovative technological solutions. We design intelligent systems for transportation and security and develop software application based on state-of-the-art digital technologies.

Aitek has emerged as a significant expression of Italian SMEs, reaching a position of technological leadership in the creation, development and integration of ICT systems in the following markets: *i*) Transport: Toll collection systems, gate automation platform, e-ticketing and digital payments solutions; *ii*) Security: Video surveillance and video analytics platform; *iii*) Digital Signage: Passenger Information and Proximity marketing.

Our solutions can be applied in heterogeneous fields like traffic monitoring, rail and subways, ports and logistics, public transport, city surveillance, cruise terminals, industrial sites, banks, health facilities, critical infrastructures, etc.

Aitek is present with its products and solutions in more than 20 countries around the world.

Artificial intelligence, machine learning, data engineering, microservices, containers, cloud computing: Aitek provides its know-how in selecting the most advanced technologies that best meet any operational need.

Today, cybersecurity is a fundamental aspect of any project. Following the security-by-design approach, Aitek solutions are designed from the beginning to be inherently secure: an innovative software development methodology, thanks to which all our systems are protected from any unexpected attacks and vulnerabilities. The result is the industrialization

of solutions that contribute to increasing the efficiency and security of our customers' activities, but also and above all to improving everyday life by making it more sustainable, simpler and more functional.

Continuing research efforts are essential to develop products and innovative solutions and maintain a high level of competitiveness. For this reason, Aitek participates in national and European funded research projects and joins in consortia and industrial districts promoting partnerships between companies, Universities and Research Organizations.

Over the years Aitek has taken part in dozens of funded research projects (see attached doc “ProgettiRicerca-v2.pdf”), at times playing important coordinating roles. Today, our commitment is aimed at developing applications based on the most advanced artificial intelligence techniques in different operating scenarios:

- Automotive: design and development of Driver Monitoring Systems installed and tested on driving simulators or real vehicles in collaboration with car manufacturers and industry-leading companies;
- People security: video monitoring of crowded environments such as railway stations, installation and testing of cutting-edge solutions for counting people
- Security of critical infrastructure: definition and implementation of video analytics applications that can be integrated into complex and heterogeneous cyber-physical systems for the monitoring of civil works;
- Road network monitoring: intelligent video analytics applications, especially focused on protecting vulnerable users such as pedestrians, cyclists and motorcyclists;
- Ports and Logistics: automation of goods handling processes and transit control systems at road or rail access gates;
- Maritime security: implementation of monitoring systems that integrate multispectral cameras and video analytics algorithms based on artificial intelligence techniques;
- Smart agriculture: video analytics applications for processing images acquired by drones;
- Retail and advertisement: in-store video analytics applications and platforms for the management of smart interactive kiosks for department stores and shopping malls.

In 1999, in collaboration with the University of Genoa's LIRA-Lab, Aitek was awarded the prestigious IST Prize for the Giotto-Retic Project: a retina-like space-variant geometry CMOS digital video camera for video communication on wireless networks (European Patent n. 1089342).

In 2015, Aitek has been one of the first Italian companies to join the register of Innovative SMEs, fully meeting all the requirements indicated in decree-law nr. 3/2015 of the Italian Government.

The choice to operate in highly innovative areas requires strong investments in industrial research and a close collaboration with the scientific and technological community. For this reason, since its very beginning, Aitek has been participating in national (Italian Government, Ministry of Education, University and Research) and European (EU's 7th Framework Programme for Research) research projects. The Company has also joined some consortiums and industrial districts promoting collaboration activities between SMEs, Universities and Research Organizations:

- National Cluster “Trasporti Italia 2020”
- National Cluster “Tecnologie per le Smart Communities”
- Regional District Tecnomar “Distretto ligure delle Tecnologie Marine”
- Regional District SIIT “Distretto Tecnologico per i Sistemi Intelligenti Integrati”
- Innovation Center SOSIA “Polo Ligure SOSIA Automazione e Sicurezza”
- Innovation Center TRANSIT “Polo Ligure TRANSIT Tecnologie e Ricerca, Network, Sicurezza ed Intermodalità nei Trasporti”.
- Aitek paid great attention to the technology transfer activities assuming a role of coach of start-up and Spin off such as Agorà/Observit (Portugal), Nextage (Italy), SurgiQ (Italy and United Kingdom), Circle Garage (Italy).
- Patents
- Constant Resolution and Space Variant Sensor Arrays - European patent nr. EP-B1-1 089 342
- Method and apparatus for determining the distance between two vehicles running along a road or motorway section, particularly in a tunnel - European patent nr. 2084689
- QR Code - Codice a barre anticontraffazione, sistema e metodo per la generazione e l'autenticazione di un titolo sulla base di detto codice N. 102017000014359
- Software registration
- AIVU – Video Security platform 10361/SIAE
- SESAMO – Automation Gate, Tolling 10362/SIAE

- TVIP – Digital Video Signage and Business tv 10363/SIAE

### 2.2.13 Participant 13 - Esaote S.p.A.: affiliated to SPOKE 2

Esaote is an international Group engaged from forty years in the research, manufacturing and commercialization of technological solutions for healthcare applications.

Today Esaote is a leading industrial Group with a unique value proposition, providing medical imaging solutions in Ultrasound and Dedicated MRI, complemented by Healthcare IT, technical service as well as by imaging technologies for the interventional sector, thus offering a broad clinical spectrum, from prevention to diagnosis and follow-up. This is made possible by developing and enhancing “light” technologies, which can be more affordable and less invasive for patients, assuring a high-quality diagnostic performance.

Moreover, Esaote has more than 20 years experience in exploiting machine learning and deep learning technologies applied to the diagnostic and interventional imaging to:

- automatize and improve the workflow of medical exams
- take over the management of repetitive tasks (e.g. extraction of measures and landmarks from images)
- improve the image quality
- add post-processing performances as fusion imaging, imaging to imaging, ...
- allow the physician to improve the speed and the accuracy of the analysis reducing at the same time the inter operator variability
- support the physician in the report activity (NLP)

Headquartered in Genoa, Italy, Esaote with a consolidated turnover of € 219,6 million in 2020, about 65% of which was generated on international markets, is currently active in 100 countries. Esaote’s research centres and production plants are located in Italy (Genoa and Florence) and in the Netherlands (Maastricht, Sittard).

The Group employs about 1,200 people, 20% of whom work in research and development, a sector in which Esaote invested € 25,2 million in Research and Development in 2020 (€ 23,3 million in 2019).

In 2020, the parent company Esaote invested € 16,4 million in Research and Development of Ultrasound and Magnetic Resonance Imaging (€ 13,9 million in 2019).

Esaote’s Research and Development (R&D) structure is divided into two Divisions, Ultrasound Research and Magnetic Resonance Research, located in Genoa with offices also in Florence and Naples.

Each structure is dedicated to basic research and the development of new technologies and new products.

The Divisions have specialized Advanced Projects Research teams, that perform basic research and exploration of new technologies and ultrasound and MRI imaging applications as AI, in collaboration with the most advanced national and international scientific and medical research laboratories where these technologies and applications are originally studied and developed.

The total number of staff of the research and development structure of Esaote, at 31/12/21, consists of 158 employees (87% University Graduates) of which 115 based in Genoa lab centres. Moreover, in Genoa are based 19 researcher of Ebit S.r.l, the Esaote subsidiary involved in designing, developing, distributing and marketing hardware and software systems dedicated to enterprise-wide workflow management in radiology and cardiology, which is implementing highly sophisticated solutions for structured medical recording, 3D/4D analysis and processing, Mobile technologies and AI solutions.

The research level of Esaote is confirmed by the 177 patent families submitted by the company, of which 6 on AI, in the field of diagnostic imaging and in particular 105 related to Ultrasound and 72 to Magnetic Resonance. In the years 2020-2021 Esaote submitted 8 new patents.

Moreover, Esaote researchers participated to the publication of several international papers (more than 30 in the last 5 years).

Esaote is currently involved in six funded projects (> 32Meuro) in the field of Ultrasound and Magnetic Resonance research: two funded by MISE (Italian Ministry of Economic Development) - CUP B46G20001250005 and MIUR (Italian Ministry of Education, University and Research) - CUP B64C12000370005, and others in the ROP ERDF (Regional Operational Program of the European Regional Development Fund).

In 2021, Esaote, as Italian company active in medical AI, has been invited by the Ministries of MUR, MISE, MITD, to cooperate with the work group on National AI Strategy.

The Ultrasound Research and Development Division, located in the Operational Site of Genoa and in the Operational Site of Florence (Center of Excellence for Probes), occupies:

- in Genoa Erzelli about 700 square meters covered, equipped with standard laboratory and test equipment
- in Genoa Multedo 300 square meters of specific test room
- in Florence over 300 square meters of laboratories dedicated to probes and transducers research.

In this sector, Esaote is involved in researching and designing portable and cart-based ultrasound systems. Diagnostic ultrasound devices make up the core business of the group and cover a wide range of clinical applications: musculoskeletal, vascular, cardiological, obstetrical and gynaecological. Systems for specific applications in orthopaedics, rheumatology, anaesthesia and A&E have also been developed in recent years.

The Magnetic Resonance Research and Development Division is aimed at the Research and Development of magnetic resonance diagnostic imaging systems, particularly for specific anatomic regions. The research activities cover the research and development aspects of all the technological components of the device, i.e. magnets, radio frequency coils, structural mechanics, hardware and software. The laboratories are equipped with laboratory systems, instruments for measurement and analysis of radio frequency and hardware control, and systems for the simulation, detection and measurement of magnetic fields for characterizing the magnetic systems developed.

Esaote was the first company to develop dedicated MRI systems for knees, shoulders and limbs, and has since become the leader in the sector, with more than 3,000 resonance systems installed in large hospitals, private clinics, sports medicine centres, rheumatology labs and trauma centres around the world. Esaote has also developed an innovative MRI system dedicated to the spinal cord in orthostasis.

## *2.2.14 Participant 14 - Philips S.p.A.: affiliated to SPOKE 2*

As a leading health technology company, Philips believes that innovation can improve people's health and healthcare outcomes, as well as making care more accessible and affordable. In concrete terms, Philips aims to improve the lives of 2 billion people a year by 2025, including 300 million in underserved communities, rising to 2.5 billion and 400 million respectively by 2030.

Guided by this purpose, it is our strategy to lead with innovative solutions that combine systems, smart devices, informatics and services, and leverage big data – helping our customers deliver on the Quadruple Aim (better health outcomes, improved patient experience, improved staff experience, lower cost of care) and helping people to take better care of their health at every stage of life.

Philips strives to deliver superior, long-term value to our customers and shareholders, while acting responsibly towards our planet and society, in partnership with our stakeholders.

Philips' goal is to grow responsibly and sustainably. To this end, Philips has deployed a comprehensive set of commitments across all the [Environmental, Social and Governance \(ESG\)](#) dimensions that guide the execution of our strategy and support our contribution to UN Sustainable Development Goals 3 'Ensure healthy lives and promote well-being for all at all ages', 12 'Ensure sustainable consumption and production patterns' and 13 'Take urgent action to combat climate change and its impacts'.

### Healthcare

Health technology is a large market, which is expected to grow by around 4% each year\*. Besides the natural drivers of growth – aging populations, the rise of chronic diseases, increased spending on healthcare in emerging markets – Philips believes that health technology will be a major growth driver in the years to come.

At Philips, healthcare is seen as a continuum since it puts people's health journeys front and centre and builds upon the idea of integrated care pathways. Believing that healthcare should, and can, be seamless, efficient and effective, Philips strives to 'connect the dots' for our customers and consumers, supporting the flow of data needed to care for people in real time, wherever they are.

Going forward, the digitalization of healthcare and – accelerated by COVID-19 – the more widespread adoption of telehealth will play an increasing role in helping people to live healthily and cope with disease, and in enabling care providers to meet people's health needs, deliver better outcomes and improve productivity.

### Helping customers address their healthcare challenges

In the consumer domain, Philips develops innovative solutions that support healthier lifestyles, prevent disease, and help people to live well with chronic illness, also in the home and community settings.

Philips is leveraging retail trade partnerships and new business models, accelerating growth through online channels, delivering products and services direct to consumers, and supporting longer-term relationships to maximize the benefit consumers can derive from our solutions.

In clinics and hospitals, Philips is teaming up with healthcare providers to innovate and transform the way care is delivered. Philips listen closely to our customers' needs and together we co-create solutions that help our customers improve outcomes, patient and staff experience and productivity, and so deliver on the Quadruple Aim of value-based care.

Increasingly, Philips is working together with our health systems customers in novel business models, including outcome-oriented payment models, that align their interests and ours in long-term partnerships. The combination of compelling solutions and consultative partnership contracts, including a broad range of professional services, drives growth rates above the group average, as well as a higher proportion of recurring revenues.

Philips is embedding AI and data science in our propositions – for instance, applying the power of predictive data analytics and artificial intelligence at the point of care – to leverage the value of data in the clinical and operational domains, aiding clinical decision making and improving the quality and efficiency of healthcare services.

With our global reach, market leadership positions, deep clinical and technological insights, and innovation capability, we are strongly placed to create further value in a changing healthcare world through our propositions in:

#### Personal Health

Delivering solutions that enable healthier lifestyles, personal hygiene and living with chronic disease.

#### Diagnosis & Treatment

- Precision Diagnosis – providing smart, connected systems, optimized workflows, and integrated diagnostic insights, leading to clear care pathways and predictable outcomes
- Image Guided Therapy – innovating minimally invasive procedures in a growing number of therapeutic areas, with significantly better outcomes and productivity

#### Connected Care

Driving better care management by seamlessly connecting patients and caregivers from the hospital to the home.

#### Front-end innovation focused on customer needs

Philips Research works in close collaboration with customers and strategic partners, driving front-end innovation and clinical research sites across the globe.

#### Addressing global health challenges

Spanning the health continuum, Philips research is clustered in five areas.

#### Precision Diagnosis

Research into Precision Diagnosis focuses on solutions that drive improved clinical decision making and efficiencies, such as smart diagnostic systems, optimized workflows, integrated diagnostics and care pathways.

#### Connected Care

Connected Care research explores seamlessly connecting patients and caregivers across care settings to deliver clinical, operational and therapeutical solutions that improve outcomes, patient and staff experiences and lowers costs.

#### Image-Guided Therapy

Research into Image-Guided Therapy develops complete procedural solutions made up of systems, smart devices, disease-specific software and services that will help caregivers decide on and deliver the right therapy during their procedures.

#### Personal Health

Philips' research into Personal Health creates innovations that serve consumers across the care continuum, by delivering personalized solutions for healthier lifestyles, personal hygiene, and disease prevention and management.

### *2.2.15 Participant 15 – MUR INFN – Istituto Nazionale di Fisica Nucleare: affiliated to SPOKE 4*

INFN is the Italian research agency dedicated to the study of the fundamental constituents of matter and the laws that govern them, under the supervision of the Ministry of Education, Universities and Research (MIUR). It conducts theoretical and experimental research in the fields of subnuclear, nuclear and astroparticle physics. All of the INFN's research activities are undertaken within a framework of international competition, in close collaboration with Italian universities on the basis of solid academic partnerships spanning decades. Fundamental research in these areas requires the use of cutting-edge technology and instruments, developed by the INFN at its own laboratories and in collaboration with industries. Groups from the Universities of Rome, Padua, Turin, and Milan founded the INFN on 8th August 1951 to uphold and develop the scientific tradition established during the 1930s by Enrico Fermi and his school, with their theoretical and experimental research in nuclear physics. In the latter half of the 1950s the INFN designed and built the first Italian accelerator, the electron synchrotron developed in Frascati, where its first national laboratory was set up. During the same period, the INFN began to participate in research into the construction and use of ever-more powerful accelerators being conducted by CERN, the European Organisation for Nuclear Research, in Geneva. Today the INFN employs some 5,000 scientists whose work is recognised internationally not only for their contribution to various European laboratories, but also to numerous research centres worldwide.

For what concerns the activities of spoke 1, INFN has solid competences on innovative detection system for nuclear security applications to be used to identify illegal trafficking of Special Nuclear Materials passing through ports in ship's cargos.

### *2.2.16 Participant 16 – E.O. Ospedale Galliera: affiliated to SPOKE 1 and 2*

Galliera operates in an area in which the prevalence of the elderly population over 65 presents multimorbidity, pharmacological polypharmacies, and is among the highest in the world. For this reason, the science of ageing has become a strategic research objective for the Hospital.

The Hospital is organised into 9 health departments, 3 administrative departments and 2 inter-departments with 404 beds. Attention is also paid to clinical and care activities, training and scientific research, aimed at the application of modern technologies and innovative organisational-management models.

In particular, the EOG has developed a significant research activity on ageing and geriatric medicine, also in collaboration with numerous national and international research institutes, hospitals and universities. The EOG is included as a specific facility for geriatric competences in the document of attribution as Reference Site of the European Innovation Partnership on Active and Healthy Aging (EIP-AHA) of the Liguria Region, being therefore authorised to use the logo and facilities of EIP-AHA. The Regional Socio-Health Plan for the three-year period 2017-19 (Deliberation of the Regional Council Legislative Assembly of Liguria 05/12/2017 N. 21) has recognised the high vocation of EOG in Geriatrics and Orthopaedics.

Ageing is a theme recognised by many as a global priority and proof of this is that the Horizon2020 call, is largely aimed at Active & Healthy Aging. In the last 10 years, the Hospital has more than tripled its scientific production, achieving a high qualitative and quantitative level of research, has applied for and obtained the candidature of European reference site on the Active and Healthy Aging theme and has set itself the ambitious goal of acquiring IRCCS status on the theme of ageing.

Galliera intends to activate all organisational and managerial initiatives to promote and enhance the research potential in all sectors of the Hospital in order to be able to promptly transfer the results of research into clinical practice, thus improving the quality of health care.

Scientific and technological development, including the increase in the use of e-health (tele-health): over the next twenty to thirty years, this will make it possible to have a health service based on predictive medicine, i.e. on the availability of personalised treatments, interventions and drugs, as well as technological and functional aids for the running monitoring of acquired pathologies.

### *2.2.17 Participant 17 - Associazione Festival della Scienza: affiliated to SPOKE 5*

AFS has been established in 2003 as a no-profit organisation for the promotion and dissemination of science and technology to the large public. All initiatives promoted by the association aim to popularize and diffuse the scientific culture, encouraging scientific education and research, training of researchers, create the public awareness and increasing the volume of scientific knowledge in order to stimulate the interest of policy makers towards investment of resources in science and technology.

The Association avails itself of an authoritative scientific committee and since 2003 has been established an international research network and collaborations with many organisations, museums and institutes in Italy and in the world. Members of the Association are CNR (National Research Council), Chamber of Commerce of Genoa, Centro Fermi, Municipality of Genoa, Confindustria Genova, Costa Edutainment, Gran Sasso Science Institute, INAF (National Astrophysical Institute), IIT (Italian Institute of Technology), INFN (National Nuclear Physics Institute), Liguria Regional Authorities, Sviluppo Genova and Genoa University.

The main initiative organised by the Association is the AFS, an annual event which, since the first edition in 2003, represents a national arena where the most outstanding scientists and researchers from Italy and abroad present and discuss their latest advancements. This event is also a unique occasion for public of all ages to “experience” science through several interactive laboratories and “hands on” exhibits.

Today AFS is recognised as one of the most important events of science communication at a European level counting over 200.000 visits each year. AFS’ distinctive feature is the large team of Scientific Explainers. The scientific explainer is the connecting link between the public and the scientific community. They assist the visitor in the discovery of the quantity of science surrounding him and the different phenomena involved (physical, chemical, etc.) It is widely recognised that the quality of the scientific explainers is fundamental for the final successful result of all exhibitions since they are the catalyst between the scientists and the visitors at the exhibition. Every year, over 500 young men and women, university students, college graduates, graduate students and young researchers turn every visit to the Festival into an enjoyable learning opportunity.

### *2.2.18 Participant 18 - Movendo Technology S.r.l.: affiliated to SPOKE 2*

Movendo Technology (<http://www.movendo.technology>) is an innovative biomedical company (Industry 4.0) headquartered in Italy (Genoa) and with subsidiaries based in Munich (Germany) and Boston (United States). Founded in 2016 as a spin-off from the Italian Institute of Technology ([www.iit.it](http://www.iit.it)) it was funded by and is an integral part of Dompé Holdings, one of Italy’s leading biopharmaceutical groups. The mission of Movendo Technology is to design, realize and implement solutions in the biomedical field using highly innovative technologies in order to improve, structure and simplify the processes of clinical and scientific activities in healthcare. Movendo’s main product is hunova, a robotic platform for physical rehabilitation, developed as a prototype by the Italian Institute of Technology IIT (Rehab Technologies facility) and industrialized by Movendo into a commercial product that is now installed in more than 130 locations (including over 70 public and private clients within the Italian territory) around the world in 12 different countries (Europe, Middle East and North America). Each year more than 15,000 patients are evaluated and treated with hunova. Movendo Technology is a member of the International Industry Society in Advanced Rehabilitation Technology (IISART: <https://iisart.org>) and over the years has won important international awards in the field of technology transfer as the EuRobotic Technology Transfer Award, industrial design with the Good Design Awards of the University of Chicago and the ADI design index and in the field of rehabilitation with the Silver Economy Awards (award given by the European Commission for the work done in the prevention of falls in the elderly). The company has established a wide network of research and clinical collaboration with major institutions in Italy and across the world to work on innovative solutions in the neurological, geriatric and orthopaedic sectors. In Italy we can mention: •in the neurological field, the University of Foggia, the IRCSS Bonino Pulejo Neurolesi Center of Messina, the IRCSS Maugeri Institute of Montescano, FDG, the rehabilitation facility Villa Beretta of Costa Masnaga; in particular on spinal cord injuries the Niguarda Ca' Grande Hospital of Milan, the A. O.U. Città della Salute e della Scienza of Turin and the A.O.U. Careggi of Florence while on Multiple Sclerosis Movendo Technology collaborates with AISM (Italian Association Multiple Sclerosis) of Genoa; •in the geriatric field, the Korian-Segesta group, where hunova is used in seven different centres located throughout the country and E.O. Ospedali Galliera in Genoa, in the orthopedic field, Humanitas Mater Domini Hospital in Castellanza and ASST Fatebenefratelli Sacco in Milan. In academic field, the UniGe, with whom the company has co-supervised PhD candidates and collaborates in research projects.

Internationally Movendo can count on several active clinical and scientific collaborations with partners of global importance. In the USA, the Hospital for Special Surgery in New York and the Kessler Institute New Jersey, respectively

classified by the U.S. News & World Report as the best hospital in orthopaedics and the second-best hospital in neurology. In Europe the Ludwig Maximilian University in Munich and the German Sport University in Cologne, Germany. These entities are actively involved together with Movendo Technology in the continuous development of solutions that use Artificial Intelligence and Machine Learning in neurology and orthopaedics to improve the diagnostic and rehabilitation aspects implemented to date, introducing predictive aspects. Movendo has also forged strategic industrial partnership with important multinational companies in the insurance sector (Generali Italia e Generali Healthcare Solutions Germany), orthopaedic surgery (Smith&Nephew) and cybersecurity of data (Leonardo) to develop and promote the use of advanced robotic and AI-based solutions to improve the quality of life of patients and general population. The company has also recently partnered with Vodafone Italia to develop a tele-rehabilitation solution based on 5G network in response to a call from the Italian Ministry for Economic Development (MISE). Movendo Technology employs a staff of highly qualified engineers with relevant experience in the field of rehabilitation, technology transfer and robotics. Over 30% of Movendo employees holds a PhD and more than 35% has a university degree. The company has obtained ISO13485:2016 and MDSAP (for USA and Canada) certifications and its products are CE, MDL (Medical Device License) for Health Canada certified, and FDA listed.

### *2.2.19 Participant 19 – ENEA – Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile: affiliated to SPOKE 3 and 4*

ENEA is a public body with the aim of pursuing research and technological innovation, as well as providing enterprises, public administration and citizens with advanced services in the sectors of energy, environment and sustainable economic development (<https://www.enea.it/en>).

ENEA supports the Country in the transition towards new production and consumption systems based on sustainable supply and use of resources and on reduction of industrial emissions and social impacts. The closing the loops approach is pursued as a necessary goal to move towards a circular economy at various levels: within production processes, in industrial areas, on urban and extra-urban areas, for land regeneration and restoration.

ENEA also develops methodologies and technologies for characterization, protection and environmental remediation with a multidisciplinary ecosystem approach by integrating skills in different environmental compartments: terrestrial, freshwater, transitional and marine. Defines the knowledge base and strategic framework for the enhancement and preservation of ecosystems and natural resources, for the reduction of their vulnerability, the mitigation of the effects and the adaptation to changes. It contributes to the development of infrastructures and services for the environment: integrated observatories, forecasting and data management systems. Works jointly with enterprises to develop innovative prototypes and tools for observation, protection and restoration of the environment.

The following ENEA Departments are involved in the project:

#### **Department for Sustainability (ENEA-SSPT)**

**SSPT** develops, implements and promotes the eco-innovation in production and consumption systems, contributing to the definition and implementation of country's strategies and policies within the overall framework of transition towards more sustainable production and consumption model.

**SSPT-PROTER-BES** develops methodologies and technologies for characterization, protection and environmental remediation with a multidisciplinary ecosystem approach by integrating skills in different environmental compartments: terrestrial, freshwater, transitional and marine. It defines the knowledge base and strategic framework for the enhancement and preservation of ecosystems and natural resources, for the reduction of their vulnerability, the mitigation of the effects and the adaptation to changes. It promotes the sustainable use of natural resources, also in the tourist sector.

Most of ENEA's activities proposed in the project will be carried at the ENEA - Marine Environment Research Centre – S. Teresa in the Gulf of La Spezia (Eastern Ligurian Sea). The Centre focuses on research and development of methodologies and tools for the protection and sustainable management of the marine environment, including the use of bioindicators to detect environmental quality and effects of climate change. The ongoing research activity in the area began in the early 1960s and then intensified starting in the 1970s, and has produced a series of long-term ecological data, included in the Long-Term Ecological Research Network (LTER: <https://lternet.edu>). Currently, historical data series of chemical-physical variables are available that have contributed to developing a better understanding of the oceanographic circulation and anomalies in physical and biological processes in this area of the Eastern Ligurian Sea.

The Centre has a strategic position due to its proximity to areas recognized as UNESCO world heritage sites for their environmental and landscape value (Porto Venere Regional Natural Park and Cinque Terre Marine Protected Area and National Park). It is also located next to areas with an industrial footprint and a strong environmental impact (port of La Spezia, ENEL power station, shipbuilding, sport/commercial fishing and shellfish farming) and constitutes an important natural laboratory for the studies of direct and indirect anthropic impacts on coastal marine ecosystems. The high concentration of companies working on marine technologies in the La Spezia area will facilitate interactions and technology transfer within the project. Furthermore, the Centre can be the venue for meetings and workshops among project partners and with the external community.

**SSPT-MET-CLIM** has a long-term experience in the application of regional atmospheric models for both the European and African regions, and of ocean circulation models for the Mediterranean Sea. The main objectives are the production of high-resolution climate data for climate impact studies (hydrology, ecosystem modelling, energy production, agro-ecological systems) and the production of high-resolution climate projections. The CLIM lab developed one of the first coupled models available for the Mediterranean region, the PROTHEUS model, to support climate and climate impact studies at regional scale.

**SSPT-USER** supports the Country in the transition towards new production and consumption system based on sustainable supply and use of resources and on reduction of industrial emissions and social impacts. The closing the loops approach is pursued as a necessary goal to move towards a circular economy at various levels: within production processes, in industrial areas, on urban and extra-urban areas. SSPT-USER activities are part of the flagship initiative for a resource-efficient Europe, launched under the Europe 2020 strategy, which promotes the shift towards a resource efficient and low-carbon economy to achieve a sustainable growth that creates economic opportunities, improves productivity, reduces costs and enhances competitiveness.

#### **Department Energy Technologies and Renewable Sources (ENEA-TERIN)**

**TERIN** carries out study, analysis, research, development and qualification of technologies, methodologies, materials, processes and products, advanced design, construction of prototype systems, supply of advanced technical services, transfer of technologies and knowledge of the production system in the sectors of renewable energy sources, technologies, devices and systems for Smart Grids, integrated energy networks and energy communities, energy efficiency and energy end uses.

**TERIN-STSN** carries out research, development and qualification of technologies, materials, processes and products in the solar energy sector for the production of heat and its use in the conversion into electricity, industrial processes and environmental conditioning. It studies and develops technologies, components and systems for the accumulation of thermal energy for various applications, both in the industrial and residential fields. The Division studies the problems of distributed generation from renewable energy sources (RES) and their integration into the network, develops methodologies and technologies for the modelling and implementation of integrated energy networks and microgrids in the presence of distributed poly-generation and energy storage systems, and the related control, management and optimization strategies. It studies and develops technologies, devices and innovative solutions for Smart Grids and energy communities.

**TERIN-SEN** carries out research, development, demonstration and dissemination of technologies and methodologies with and for the production system, institutions and citizens, in the sector of end uses, in particular in the contexts of metropolitan areas, in the integration between distributed systems of energy production, transmission and use, in the interconnection between local systems and national energy networks. It bases its methodological approach in the holistic ability to model systems by producing innovative services, efficiency and safety on the basis of the innovative organization of the systems themselves (energy on demand, interoperability), making use of ICT as an enabling technology for interrelation of networks and components and for the satisfaction of the needs of the person. The strategic objective consists in the development of technological platforms capable of changing the organization of urban and territorial infrastructures to improve their energy efficiency and performance, economic competitiveness, social acceptability, market penetration.

ENEA collaborates closely with all main Italian research institutions and has been involved in a wide range of national and international projects, also as coordinator, on topics related to the proposed activities (e.g. MINKE (H2020-INFRAIA), BIOROSS (PNRA), DIP (POR FESR Liguria), UNDROID (POR FESR Liguria), TEOREMA (MUR), Tonga (MiTE per PVS), Vanuatu (MiTE per PVS), OPERATE (MiTE per PVS), MACMAP (INGV), B-Blue (INTERREG MED), RECOMARES, Guardiani della Costa (Fondazione Costa), Mirror Copernicus, LabMare (DLTM), Seadatacloud (H2020-INFRAIA), Emodnet Data Ingestion (UE - EASME), CISAS (CNR), LTER network, RIMA

(MUR), Green Stars Project, LTER Network). It has, the ability to manage and implement complex projects in synergy with the research system, public authorities and the productive system. Being ENEA a research institution with a vocation for technology transfer it has extensive experience in interacting with the industrial sector, also through its partnership with the Distretto Ligure delle Tecnologie Marine with which strictly collaborates.

### *2.2.20 Participant 20 - Fondazione Italiana Sclerosi Multipla Onlus: affiliated to SPOKE 1 and 2*

The Italian Multiple Sclerosis Society (AISM), through FISM, is the leading funding agency of research in Multiple Sclerosis (MS) field in Italy and the third funding agency worldwide (after US and Canada MS Societies) to better understand the causes of the disease, to improve the quality of life of people with and affected by MS (PwMS) and to provide better treatments toward a definitive cure for a MS.

FISM is member of the International Research Staff Network, which includes staff from all the key MS organisations amongst the membership that have common research agendas and dedicated research infrastructures and of the International Medical and Scientific Board (IMSB), that has the role to advise on matters related to international MS research, and to form a professional link between the MS medical and research community. FISM promotes relevant international initiatives and networks as the Progressive Multiple Sclerosis Alliance (PMSA), the Pediatric MS Networks and the European MS Platform (EMSP).

In this context, AISM/FISM promotes intramural and extramural research.

FISM, finances, influences and promotes research in the fields of Rehabilitation: health monitoring, innovative ICT-based treatments and personalized protocols, predictive medicine, personalized medicine, anatomic-functional correlates, enabling technologies, functional outcomes, patient-centred outcomes research, rehabilitation treatment effectiveness, sport, well-being and physical activities for PwMS. The Scientific Research Area of FISM is composed by a multidisciplinary team with competencies in different disciplines related to the medical field. Specifically, the research is carried out by researchers with background as psychiatrist, physical therapist, psychologist, neuropsychologist, bioengineer and biostatistician.

FISM have got technical experience in machine learning techniques, apps development and continuous monitoring. Specifically, previous experience focuses on:

**Predictive models:** FISM developed in collaboration with UniGe a model able to predict the disease shift from relapsing-remitting to secondary progressive MS course. The model, published on an international peer-reviewed journals, analyses patients-centred outcomes measures acquired from PwMS in the context of two projects funded by FISM: “A new functional PROfile to MONitor the PROgression of disability in Multiple Sclerosis.” (PROMOPRO-MS), FISM Special Call 2013; “Early DETECTION of Multiple Sclerosis progression driven by clinical scales and Patient Reported Outcome” (DETECT-MS PRO), FISM Call 2015.

**Monitoring tool:** FISM is developing an unobtrusive mobile tool (i.e. MAPPINGMS-tool) for the individual continuous monitoring of physical, cognitive and psycho-emotional variables in the context of a project funded by FISM: “MAPPINGMS: Mobile Application for monitoring of motor-cognition-emotion in Multiple Sclerosis.” (MAPPINGMS), FISM Special Call 2016. Moreover, FISM takes part of the international IMI project “Validating digital mobility assessment using wearable technology – the Mobilise-D MS STUDY” devoted to the monitoring of people with different clinical conditions MS included; and the international Horizon 2020 project “ALAMEDA - Bridging the Early Diagnosis and Treatment Gaps of Brain Diseases”, aiming at providing personalised rehabilitation treatment assessments for patients with Parkinson’s, Multiple Sclerosis and Stroke and ensuring that medical interventions are effective and that situations likely to aggravate can be predicted through the use of Artificial Intelligence healthcare support systems.

**App development:** FISM get experience on the design, development, usability and satisfaction testing in using mobile solution; specifically, COGNITRACK (SIAE registration number 008950; D008111, 20/08/2013) an app for working memory rehabilitation as result of a project on cognitive disorders in MS funded by FISM (“The impact of motor and cognitive rehabilitation on the dynamic properties of brain structure: towards the individual tailoring of therapeutic interventions in Multiple Sclerosis patients”, FISM Call 2011), CMI-APP an app for assessment and training of dual-task performances as result of a project on dual-task rehabilitation funded by RIMS (“Cognitive-motor interference in persons with MS: dual task assessment & training. A multi-centre study (MCS-IV-CMI&DTT)”), and ABOUTCOME (waiting for SIAE approval) an app for the digital collection of patient reported outcomes as result of a project on upper

limb performances evaluation of PwMS (“Upper limb function in MS: creation of a normative data set on subjective and objective measures and the construction of an MS-specific assessment tool”, FISM Call 2014).

With the aim to better integrate patients’ perspectives, needs, and priorities across the FISM research is carried out following a multi-stakeholder approach. In this context, FISM coordinated the MULTI-ACT initiative for stakeholders’ engagement (European Union’s Horizon 2020 Research and Innovation Programme under the Grant Agreement No. 787570) with the aim to increase the impact of health research on people with brain disorders by providing a framework and tools for multi-stakeholder health research initiatives, allowing an effective cooperation of all the relevant stakeholders and the alignment of the results to the mission and agenda.

Framework agreement with IIT. 1) Co-design and validation of novel technological solutions for diagnosis, monitoring and rehabilitation and improvement of quality of life; 2) validation of rehabilitative protocols; 3) neuroimaging studies; 4) study on cognitive and motor deficits in MS. These initiatives are supported by the exchange of knowledge and resources between FISM and IIT researchers. Some of the ongoing research studies and initiatives are:

ENACT (Employing Neuroergonomic solutions to Attenuate the Cerebellar Tremor) is a project supported by AISM with a grant of its Foundation to design and develop wearable technologies and interactive environments to investigate, assess, and mitigate the cerebellar tremor (in terms of intention tremor of upper limbs), and to enhance motor and cognitive rehabilitation procedures (Rehab Technology, IIT).

Testing iFeel technology on PwMS. The aims of this research proposal are to 1) test usability of the use of iFeel, whole-body wearable system developed at IIT that consists of a network of wearable devices, called Nodes, force/torque sensors, an AI-based estimation algorithm; 2) to examine the reliability of quantitative measures derived from iFeel during the standard evaluations for walking and balance in PwMS. The iFeel components enable the real-time tracking of the human kinematics (positions, velocity and accelerations) and dynamics estimation (external and internal forces, as well as articular stresses in the form of joint torques) (Artificial and Mechanical Intelligence, IIT);

Investigating temporal, spatial and multisensory perception in PwMS. the aim of this project is to investigate sensory mechanisms with a multimodal approach based on psychophysics, neurophysiology, and cognitive neuropsychology. This study will enhance the understanding of sensorimotor impairments relative to MS and reveal potential neuro-markers that will help to understand cognitive, motor, and psychological symptoms. Furthermore, it will provide useful information for the implementation of neuropsychological interventions in the PwMS, so that specific protocols can be designed and tailored to the specific individual, even outside the laboratory environment (Unit for Visually Impaired People, IIT);

Gameability is an educational initiative in collaboration with IITIS Delpozzo (Cuneo, Italy) high school students attended lectures of experts of FISM and IIT for learning how to design rehabilitative exergames for people with Multiple Sclerosis. This educational approach aims at making the students aware of the difficulties faced by people with neurological disabilities as MS through the practice of user-centred game design, also considering the opportunity of creating exergames playable by healthy people too (<https://www.gameability.it/>).

### *2.2.21 Participant 21 - Fincantieri S.p.A.: affiliated to SPOKE 4*

Fincantieri, big company, is one of the world’s largest shipbuilding groups and number one by diversification and innovation. It is leader in cruise ship design and construction and a reference player in all high-tech shipbuilding industry’s sectors, from naval to offshore vessels, from high-complexity special vessels and ferries to mega-yachts, ship repairs and conversions, systems and components production and after-sales services. The Group has built more than 7,000 vessels in over 230 years of maritime history.

Fincantieri is now the largest shipbuilder by revenue in the Western world (meaning Europe and North America) and one of the most dynamic and diversified players in the industry, being focused on high value-added segments with high-tech content and high unit values, and with a position of excellence in all these segments that make it one of the most technologically complex groups on the international scene. In fact, the Group is a world leader in the design and construction of cruise ships, among the world leaders in the design and construction of naval combat, support and special vessels and submarines, and one of the leading global players in the design and construction of high-end offshore support vessels.

Fincantieri is active worldwide on four continents (Europe, North America, South America and Asia), with 21 shipyards located in Italy, Norway, Romania, United States of America, Brazil, and Vietnam plus a joint venture in the United Arab Emirates, and a total workforce of more 20,000. Fincantieri's business is widely diversified by end markets,

geographical exposure and by client base, with revenue evenly balanced between cruise ship, naval and offshore vessel construction. Compared with less diversified players, such diversification allows it to mitigate the effects of any fluctuations in demand on the end markets served. In particular, the Group operates through the following segments:

- Shipbuilding: encompassing the business units that build cruise ships and naval vessels and offer other products and services (ferries, mega-yachts and ship repairs and conversions);
- Offshore: encompassing the design and construction of high-end offshore support vessels, specialized ships, and vessels for offshore wind farms and open ocean aquaculture, as well as the offer of innovative products in the field of drill ships and semi-submersible drilling rigs;
- Equipment, Systems and Services: encompassing the design and manufacture of high-tech equipment and systems, such as stabilization, propulsion, positioning and power generation systems, ship automation systems, steam turbines, and the provision of logistical support and after-sales services.
- For Fincantieri, innovation is one of the key factors for maintaining competitiveness. Making innovation does not only represent the improvement or invention of new technologies. Innovating means being able to identify and monetize the added value generated by new technologies and process improvements.
- To do this it is essential, given its role as integrators, to collaborate in a win-win logic (for example by providing exclusives or particular protections) with all the players in the vast network of collaborators and suppliers. This allows to consolidate the competitive advantage and strategic positioning of the Group on high-tech products and high added value, in a highly competitive globalized context.
- The Group's research and development activities are organized along three fundamental lines:
- development of technologies and innovation applied to new shipbuilding contracts: activities aimed at developing technological solutions, materials and innovative systems, carried out during the ship design process and necessary to meet the specific needs of shipowners;
- off the shelf innovation: activities aimed at developing specific design solutions not directly applicable to shipbuilding contracts but necessary to anticipate customer needs, for example in areas such as energy efficiency and reduction of operating costs, maximization of payload and perceived quality and improved safety;
- long-term innovation: i.e. activities aimed at developing the Group's technologies also in order to support entry into new business sectors.

The consolidation of a common path with its European partners for R&I in shipbuilding represents one of the most ambitious objectives that the Group intends to pursue in the coming years and from which it intends to orient its work. The network of collaborations that Fincantieri has established at an international level and its commitment to a future of sustainable progress, as indicated in the Group's Sustainability Plan, has enabled it to guide the definition of the national and European strategic agenda for the sector, for the purpose to create the necessary preconditions to maintain its competitiveness on global markets.

Fincantieri innovation agenda is articulated in three main directions: Environment, Digitalization and Competitiveness each of which is articulated in goals, application areas and technologies.

Environment - Since a couple of years, the concept of environmental care has become one of the guiding principles for innovation processes and has gained fundamental importance for the sustainability of human activities on the planet. Fincantieri is committed to further increase the level of sustainability of orders and to reduce their carbon footprint throughout the entire product life cycle. These objectives represent the milestones of our vision and stimulate our innovation activities also to address emissions reduction (both in air and water), to improve waste management on board and to reduce noise and vibrations. This approach implies that all new technologies are aimed at decarbonisation and the switch to green fuels.

### *2.2.22 Participant 22 - Ansaldo Energia S.p.A.: affiliated to SPOKE 3*

Founded in 1853 and headquartered in Genoa, Ansaldo Energia (“AEN”, the “Company” or the “Group”) is a leading international player in the power generation industry covering all the activities needed to supply turnkey power plant or power equipment solutions. The Three main business line of Ansaldo Energia are:

New Units Operations – design, test and manufacturing of all the products of its portfolio, which includes gas turbines (80 – 540 MW), steam turbines (40 – 1000 MW), generators (40 -1200 MVA) and microturbines with the goal to satisfy the customer needs with a full Engineering, Procurement and Constructions capabilities.

After Sale Service – providing maintenance and overhaul services for its own and third-party gas turbines, steam turbines and generators, through upgrades, tailored solutions and continuous improvements. Digital solutions allow Ansaldo Energia to remote monitoring their fleet and ensure immediate assistance and intervention.

Nuclear – supplier of new nuclear power plants (as EPC contractor), service work on power plants in operation, decommissioning of nuclear plants and radioactive waste management. With its subsidiary Ansaldo Nucleare, it is also part of ITER, the world's largest nuclear fusion project, an important step towards clean and reliable energy for future generations.

In addition to the Company Headquarters in Genoa (where more than 120000 sqm are dedicated to production activities), 2 facilities in Abu Dhabi and Shanghai are operating as repair centres. Ansaldo Energia has constantly been committed to a sustainable and innovative power generation with the aim to ensure a lower environmental impact and a high flexibility in energy production.

The key numbers of Ansaldo Energia are (as per official 2020 balance sheet): More than 3200 employees; 1,089 M€ of Revenues; 30 Branches and subsidiaries; More than 2300 patents; 6% of R&D spending.

Ansaldo Energia, consistently with the industry trends of the energy transition, has in the last years maintained a high level of spending in research and development activities, aimed to maintain product offering in line with the highest technological level of the worldwide competition arena.

Main lines of development for the New Units and Service Business were devoted to improving efficiency and operating flexibility of turbomachinery product lines in compliance with the most stringent requirements on emissions, and in combination of extensive development and implementation of digital solutions. Ansaldo Energia is also exploring new portfolio elements in growth field that can support the energy sector decarbonization through green hydrogen and energy storage technologies.

In order to improve its technological level and know how Ansaldo Energia can rely on a large network of partners including main universities in Italy and Europe, others technological partners and centres of excellence in several fields of application. In the list below, an overview of the main funded research projects carried out by Ansaldo in the last years is outlined:

#### Ministero dello Sviluppo Economico (Italy) – Several MISE projects

- MISE 1: Development of GTs with low emission of greenhouse gases and high operational flexibility through the use of innovative materials and advanced production systems
- MISE 2: Development of advanced systems for the stabilisation of thermoacoustic phenomena in combustion processes for gas turbines with high efficiency and low environmental impact European Commission - Flexible Fossil Power Plants for the Future Energy Market through new and advanced Turbine Technologies (FLEXTURBINE)
- European Commission - TURBOmachinery RETrofits enabling FLEXible back-up capacity for the transition of the European energy system (TURBO REFLEX)
- European Commission - Performance Untapped Modulation for Power and Heat via Energy Accumulation Technologies (PUMP HEAT)
- European Commission - POLLution Know-how and Abatement (POLKA)
- European Commission – Digital Mentorship program for SMEs
- Ministero dello Sviluppo Economico (Italy) & Regione Liguria \_ LHP project Lighthouse Plant
- BEI - European Investment Bank - ANSALDO INNOVATIVE GAS AND STEAM TURBINE DEV
- Ministero Istruzione, Università e Ricerca Scientifica (MIUR) Smart systems applied to power generation plants to satisfy flexibility requirements (SIIT Energia)

#### 2.2.23 Participant 23 - Circle S.p.A.: affiliated to SPOKE 4

Circle is leading a consultancy and IT group providing process and management consulting services, innovative technological solutions and digital solutions for transport and logistics sector.

On the industrial level, Circle is a company oriented to innovation and characterized by a European dimension of the business focused on digitalisation of the maritime and logistic industries leading to a higher operative efficiency and effectiveness of its logistics chain customers. Specialized in the development of automation processes for ports, dry

ports, logistics platforms and intermodal operators, the company numbers today in its team nearly 70 professionals mainly involved in business process analysis, software development and in EU funded projects.

The main Circle's products are:

- MILOS Global Supply Chain Visibility: a Corridor Management Platform able to digitally connect public and private actors on the logistics chain (e.g. implementing the so-called Fast Customs Corridors, implying the full digitalisation of the transport corridor between ports and inland terminals combining digital data coming from public and private actors and from all modes including rail)
- MILOS MTO: a full cargo management system for intermodal (railroad) operators covering all the different processes to effectively manage multimodal cargo deliveries
- -MASTER SPED: a product for freight forwarders covering road, rail, maritime and air shipments and specifically customs operations
- -SINFOMAR, an advanced Port Community System with a high level of digital integration between transport modes.

Thanks to the deep experience of its management in innovation, Circle assists both public actors and private companies in developing their new businesses.

On the consultancy and EU-funded projects level, Circle's strengths are high level experience in EU project management (the Project Leader has 20 years' experience) and a relevant experience in digitalisation in logistic with more than 10 EU projects in this field in the last 3 years, involving shippers, shipping lines, port Authorities, port terminals, inland Terminals, multimodal transport and logistic operators, rail operators and inland waterways Authorities.

#### References

Providing technical assistance to the AnNa coordinator (the Dutch ministry of transport). In this field, Circle has offered its know-how for supporting the effective implementation of the EC Directive 2010/65/EU. The assistance given were centred on three parts, namely:

1. Development of a Master Plan: a common implementation framework for Directive 2010/65/EU to ensure appropriate European interconnectivity in accordance with the specifications as developed by the coordinating expert group (eMS) describing and elaborating the requirements to implement the Directive as well as communality issues between the countries. This Master Plan relates to issues concerning the minimum implementation of Directive 2010/65/EU whilst facilitating, where practicable, more advanced implementation, and thereby cooperation between Member States.
2. Development and execution of national pilot projects. The pilot projects were clustered amongst three categories with a focus on:
  - a) Electronic data submission by the reporting party (the front desk).
  - b) The national (internal) solution (the mid office).
  - c) Electronic data exchange between the participating countries including existing exchange mechanisms (the back office).
3. Development of a Master Plan "Extended Collaboration": identifying the steps requiring further collaboration, e.g. to develop a system that allows ships to report only once when sailing between different EU ports; connecting the Maritime Single Window to national logistics platforms, elaborating on e-Freight developments and other initiatives.
4. Contract MOVE/DDG2.D1/2018-FV-377 "Support action for contributing to the establishment of a European Maritime Single Window environment". A final report, several country fiches and a database were delivered.
5. Contract MOVE/C4/2018-224 - Study on the opportunities to evolve TAF TSI to exploit synergies with e-enhanced multimodal logistics.
6. Circle is involved in 4 recent CEF projects stemming from the digitalisation call, all related to port and logistic data sharing (FENIX, FEDERATED, E-BRIDGE and IRAIL).

#### Other references

1. Circle is coordinating the H2020 CSA on the port of the Future called DocksTheFuture, aiming at designing the vision of the ports in Europe in 2030 with a specific focus on digitalisation. It includes an extensive research and review process of a large group of external experts, with a renowned reputation in Europe. Workshops were organised and lead with over 150 participants (2018-2020).

2. Circle is the leading consultant supporting the EU Coordinator for Motorways of the Sea Prof. Kurt Bodewig in the development of the Motorways of the Sea Detailed Implementation Plan and of the related studies. Within the Motorways of the Sea priorities, digitalisation represents one of the most relevant one in the second pillar Maritime transport integration in the overall logistic chain.
3. Vertical solutions and know-how in the fields of intermodal freight transport, rail, ports, inland terminals and logistics. Circle, through its own company Infoera manages the development and the operation of the Port Community Systems in Trieste. The Circle group is also providing solutions for shipping agents and freight forwarders. Therefore, the company has a in depth knowledge of all the data sharing needs and constraints in the maritime and logistic sector.
4. Particularly through the development of innovative applications, integration and use of mobile, RFID, OCR, Laser, NFC technologies, Circle provides solutions for optimizing management of terminal operations, the automation of all data procedures and gate operations, the complete traceability of goods throughout the logistic chain and the simplification of customs procedures.
5. Consultancy in business development and EU funding. Specifically concerning logistics, Circle is currently involved in several projects which are supporting the EU policies in the e-freight, e-customs and e-maritime domains such as WiderMos and Anna. Moreover, Circle is offering its consulting services to strategic customers in public and private companies that would like to share this opportunity to develop their business using co-funded projects.
6. In terms of representing the maritime and the logistic industry, Circle manages the website [www.onthemosway.eu](http://www.onthemosway.eu), a digital multichannel platform dedicated to Motorways of the Sea themes, meaning door to door maritime and logistic chain, with specific content on digitalization of transport and logistic. The services provided by the portal include a by-weekly newsletter sent to 1800 email stakeholders in the field.

### *2.2.24 Participant 24 – Istituto Nazionale di Geofisica e Vulcanologia: affiliated to SPOKE 3*

The main mission of INGV, one of the largest research institutions of Earth Sciences in Europe, is to deal with phenomena in solid and fluid Earth System components, managing monitoring networks and collecting, inspecting, and disseminating data in the field of seismology, volcanology, geomagnetism, space weather, geochemistry, environment, security, marine sciences, and risk management. INGV is, by law, the reference institution for Italian governmental bodies in the field of geo-hazards. Also, INGV is recognised by UNESCO as tsunami early warning centre in the Mediterranean Sea. In cooperation with civil and military authorities, INGV has developed highly technological infrastructures aimed at hazard mitigation, data exchange and interoperability to manage crises, both at national and international level. These goals have been achieved participating and coordinating several EU research projects. In addition, INGV is the representing entity of EMSO and EPOS, two European Research Infrastructure Consortium (ERIC) coordinated by Italy.

INGV is involved, usually as a leader and managing institution, in several international research and training programmes. Some important examples are:

- European Multidisciplinary Seafloor and water column Observatory (EMSO)
- European Plate Observing System (EPOS)
- EU project, “Initiatives supporting and improving the European Multidisciplinary Seafloor and water column Observatory and its activities – InSea”
- MARE/ 2012/ 11 – Lot 2 The Mediterranean – Growth and innovation in ocean economy- Gaps and priorities in sea basin observation and data”

As INGV is involved in so many research programmes, it has several key research facilities, infrastructure, and equipment that enables it to implement complex/excellent projects. Indeed, INGV is distributed all over the national territory (Rome, Palermo, Catania, Naples, L’Aquila, Pisa, Bologna, La Spezia, Milan). The headquarter is in Rome (via di Vigna Murata 605, Rome - Italy). INGV laboratories and infrastructures represent an enormous heritage acting as an attraction pole for researchers from national and foreign institutions. Technology innovation is part of INGV mission, as well as multidisciplinary monitoring networks around the Mediterranean Sea which continuously collect data. Several data centres and High-Performance Computing facilities guarantee data storage and real time processing. For underwater applications, INGV has an AUV (able to reach high depth) able to host payloads for testing in deep water. Technology innovation proposed in this programme will be developed within the Rome 2 Department which

covers a broad spectrum of issues related to geophysical and environmental sciences. In particular, the research of this Dept focuses on the study of geomagnetism and magnetism of rocks in various applications, on systematic observations of space and ionospheric phenomena, on environmental geophysical investigations, on multidisciplinary marine studies and on electromagnetic and geophysical measurements for environment and for the territory and, finally, on national and international security issues.

INGV will contribute to the Spoke 3 with three main activities.

First, in collaboration with Unige-DITEN, it will implement a -sea wave and rain- monitoring system based on remote-sensing stations (OS-IS) and Smart Rainfall Systems (SRSs) to provide data for 1) weather (specifically sea and rain) model validation and for 2) early storm warning systems. OS-IS was designed and tested in collaboration with AGI S.r.l and MARIS scarl, within the project 'Wind, Ports and Sea', an EU project developed as part of Italy-France Maritime Cross-border Cooperation Programme 2007-2013. Experimental confirmations of the effectiveness of the SRS technology were obtained by Artys within the POR-FESR "PIM project" with the creation of use-cases in Liguria in collaboration with INGV and the Unige-DITEN. The mentioned technologies (OS-IS and SRS), will be further developed using machine learning methods to evaluate more accurate and exhaustive weather (sea state and rain) measurements from raw data. Beside INGV and Unige-DITEN, this activity will be conducted in collaboration with AGI S.r.l, Maris scarl, Artys S.r.l, and the DLTM (Distretto Ligure Tecnologie Marine). The latter will provide a high-performance computing facility for the data management and machine learning development.

Second, INGV will develop of a novel sensor system, called VS-AAI, consisting of hydrophones and triaxial high-sensitivity accelerometers, for underwater measurement of signals within the bandwidth 0.001Hz-2KHz. Processing the raw data with machine learning methods, the system can provide us valuable information about the underwater environment. This sensor system will be developed in collaboration with AGI S.r.l, Maris scarl, and DLTM.

Third, INGV will provide an AUV (10 m long for a maximum depth of 3000 m) for deep-sea exploration and device testing. The AUV was designed and built by ENI S.p.A. and recently upgraded by INGV with PON infrastructures funds. It can be moved to Liguria and used as an underwater laboratory for testing new systems developed in the framework of Spoke 3.

### *2.2.25 Participant 25 - Info Solution S.r.l.: affiliated to SPOKE 3*

Info Solution is an Italian company founded in 1998 carrying out software development, design and production (Original Design Manufacturer) of embedded systems including mechanics, Hardware, Firmware, Software. The initial activities were in the field of design and implementation of software as consultancy activity in the aerospace and defence field. Over the years the range of services expanded from analogue and digital electronics, embedded systems to firmware up to software and artificial intelligence, IoT and mechanics. The types of customers have diversified over the years, including household appliances, home automation, telecommunications, transport and logistics, electro-medical, telemedicine, energy and utilities, as well as the initial aerospace and defence sectors. In order to diversify the business portfolio, in 2008 the company decided to dedicate a new division to research and innovation and therefore to the creation and selling of its own products. The division dedicated to research has been using, since 2008, funds obtained through the assignment of grants won on both civil (EU, National) and military (DNA PNRM) research calls. These researches have allowed the creation of prototypes, some of which have now become products that the company offers on the market. From 2020 Info Solution chooses to devote all its energies to research and innovation activities and to the design, production and selling of the products created during the years dedicated to research projects. These products continue to be perfected through continuous scientific and technological developments and at the moment consist of:

- Autonomous driving system for land vehicles in smart farming, safety, security, and logistics missions;
- Sensors and systems for tele rehabilitation;
- Bed mover, a vehicle aimed at advanced handling for hospital beds;
- RFID traceability systems in the healthcare sector of monitoring of the transfusion process;
- Wireless remote reading of smart meters for accounting purpose;

In the fields of **autonomous vehicles** we built some autonomous ground vehicles able to carry out several kind of missions: logistic (unloading pallets from trucks), mobility aid (autonomous wheelchair, hospital bed

mover), security and exploration (automatic patrolling, precision farming) and military (Intelligence & Surveillance). All the vehicles are able to "perceive" the environment and autonomously navigate in it avoiding unexpected obstacles. Our Military AGVs carry out Intelligence & Surveillance tasks providing a very precise 3D reconstruction of environment, even in case of attack to the GPS. The field of **environment perception and Artificial Intelligence:**

consists in the use of techniques designed to "understand" data from cameras, sonar, laser, IMU etc. aimed to explore the environment and perform 3D modelling as well as the identification of objects or situations of interest. Here applications range from tracking of surgical instruments, to self-localization, tracking and target modelling algorithm, video surveillance and precision farming.

### Research projects

In recent years Info Solution has invested private funds and co-financed research projects won on national and European tenders (FP7), to date 9 projects concerning the field of autonomous vehicles and the perception of the environment are completed or in the process of being completed, for an overall investment to date exceeding € 2 million spread over the years; these were preparatory actions for this project and which continue today in synergy with the development proposed here.

Info Solution through its offices in Milan, Rome, Catania and Taranto developed several research projects with various research centres (La Sapienza University of Rome, Polytechnic University of Milan, University of Milan Bicocca, CNR, Policlinico Umberto I of Rome Clinical Institutes of Specialization, Bambino Gesù Pediatric Hospital, Maugeri) and companies. The research funds are partly own and partly come from civil (EU, National) and military (PNRM DNA) sources.

### Business, internationalization and products

Info Solution believes in the industrialization of the products created through the work of research and innovation.

**Cheonix** is a division created thanks to the expertise acquired through WSN projects; today it designs, manufactures, installs, maintains telemonitoring and remote metering equipped with smart sensors.

**Save Energy** is a spin-off dedicated to the market created thanks to the work done by the R&I, it has the mission to design, plan, create products and services for energy efficiency and the rational use of energy in homes in Italy and abroad. We sold this start-up, the volume of sales was € 7 million over three years to cover our initial investment of 1 million. (ROI greater than five times). Given the success of that initiative, the company sees in the diversification of the business portfolio and in particular on becoming a product company the best strategy for its development.

Through the assignment of the first Italian Pre commercial procurement conveyed by the Niguarda hospital in Milan Info Solution developed "BeN Bed Mover" a semi-autonomous vehicle piloted by an operator equipped with a collision avoidance system that allows the movement of hospital beds between the operating rooms and the patients rooms. The vehicle is patented, certified and currently on sale.

**Moliris** (<https://www.infosolution.it/en/guida-autonoma-2/autonomous-mobile-robots>) is an info Solution brand dedicated to systems for localization and navigation for vehicles. Through this brand, the company has begun to sell the first autonomous robots and thanks to this project Info solution intends to complete new versions of the system that can be sold on specific markets.

Because of all these activities and the competences developed, the implementation of the project presented here represents the use of the skills acquired over the years of research combined with a highly innovative contribution from the academic world exploited to diversify the autonomous vehicle product to use it in the environmental caring and protection, thus improving competitive positioning.

The company is not new to the creation of product divisions, this path has already been successfully followed through the spinoff "Save Energy", the Kedos-net product, the aforementioned hospital vehicle so we are aware of the dynamics that come to be established in this step that we are able to face with confidence. The potential repercussions on company growth are projected over a short-, medium- and long-term horizon, and consist in the opening of a new business to be added to the current portfolio of the company.

As represented in the individual participants' detail sheets, the skills present in the ecosystem guarantee the proposal's implementation capacity and the pooling of numerous national and international experiences.

The presence of a single university (the University of Genoa is the only one in the area, but it guarantees a strong multidisciplinary and articulated presence in all the provinces of the region through its decentralised branches) is compensated by the participation of all the major National Research Institutions (ENEA, INGV, INFN), which guarantee access to scientific, technological, educational and technology transfer competences also outside the Liguria region, if necessary.

For example, the participation of the CNR (Italy's largest research body) makes it possible to provide considerable breadth from both a scientific and training point of view, given the body's role in the coordination of a number of national programmes (e.g., the National Doctorate on Artificial Intelligence involving 61 universities and research bodies, divided into five doctorates each in an area of specialisation in AI ([www.phd-ai.it](http://www.phd-ai.it))).

Similarly, another valuable element is the participation of IIT, CNR, and UNIGE (as promoters) in the National Doctorate in Robotics and Intelligent Machines (DRIM) in which more than 20 Italian universities participate.

### *2.2.26 Members of the Hub*

As presented at the outset of the present Section, the Hub of the ecosystem will include 9 members: UniGe, CNR, IIT, CIMA – which are also part of the Spokes – and Regione Liguria, FILSE, Liguria Digitale, ANCI Liguria, and Job Centre. While Regione Liguria certainly does not need any introduction or presentation, the following paragraphs present the remaining members of the Hub that have not been already presented as participants in the various Spokes.

#### *2.2.26.1 F.I.L.S.E. S.p.A.*

FILSE is the technical body that supports and assists Regione Liguria and the other Ligurian territorial bodies in the planning, definition and implementation of policies and interventions to support the Ligurian economic system.

As an in-house structure of Regione Liguria, its action is mainly part of the Region's economic strategy aimed at supporting the overall strengthening of enterprises and the structural growth of the regional production system. In this sense, FILSE is a primary point of reference not only for the regional government, but also for local authorities and the productive and entrepreneurial fabric. Its strategy, in fact, is aimed at supporting with adequate financial, planning and organisational resources the entrepreneurial and production initiatives capable of promoting territorial development, at all levels. The action of FILSE refers in particular to the "technical-operational support" to the policies of environmental requalification and support of economic development", to the management and programming of public financial instruments for Ligurian SMEs and public subjects, to the definition of an institutional, regulatory and management architecture of the new strategy of "innovation and research" and to the constant development of projects and services aimed at supporting every sector of the Ligurian productive economy. FILSE also acts as an instrument for the management and unification of regional participations in companies, participations that it coordinates and organises on the basis of specific regional directives.

The Finanziaria Regionale and its subsidiaries operate as an "integrated system" for the management of EU, national, regional and municipal funds, for the participation in the capital of enterprises, for internationalisation, territorial marketing, the recovery and regeneration of industrial areas, the support to the social economy, the development of new infrastructures and the definition of energy policies. This is a highly diversified field of action, but one that ends in a single major objective: "Supporting a growing Liguria".

#### *2.2.26.2 Liguria Digitale S.p.A.*

Liguria Digitale is an in-house company of Regione Liguria committed to the development of the digital strategy of the Region and its member bodies for citizens, businesses, tourists and the Ligurian public administration.

Liguria Digitale carries out innovative and technologically advanced projects, to provide everyone with easily accessible digital services and information.

In order to guarantee quick and easy access to the services, together with the Liguria Region and its member bodies, Liguria Digitale is committed to strengthening the digital infrastructures (broadband and wi-fi) throughout the Ligurian territory and the IT security and operational continuity of the system, through its own data centre and service-oriented cloud architectures.

#### *2.2.26.3 ANCI Liguria*

ANCI Liguria represents all the local public entities of the Region, including municipalities, provinces, and the metropolitan city of Genova.

In its capacity as technical coordinator of the 4 so-called "Aree Internee" – the areas of the interior, namely A.I. Valli dell'Antola e del Tigullio, A.I. Beigua SOL, A.I. Valle Arroscia, A.I. Val di Vara – ANCI Liguria is supporting the municipalities within these areas to embrace and implement a number of innovations, including in particular interventions in the healthcare sector – such as telemedicine – which are of extreme relevance for these relatively secluded and less well-connected areas. In the framework of RAISE, ANCI Liguria is going to play a particularly relevant role to ensure that the needs of these areas of the interior are duly taken into account when conducting research and developing innovative solutions.

Moreover, ANCI Liguria is also involved in addressing the big challenges of the green transition and the prevention on environmental risks (e.g. fires, floods, coastal erosion, etc.), which constitute the key challenges that local entities in Liguria are facing due to the peculiar complexities of the morphology of the Region. In the framework of territorial cooperation projects, ANCI has also developed a range of good practices in the fields of green ports, noise mitigation, forest firefighting, communication, citizen inclusion and public engagement.

In addition to sharing its expertise, ANCI Liguria will also benefit the ecosystem by facilitating a continuous interaction with all the entities of the territory, which is envisaged to become the real testing ground of all the innovations that will be developed, and the launching pad to transfer all innovative solutions from the testing labs to the broader market.

#### *2.2.26.4 Job Centre S.r.l.*

Job Centre is a single shareholder company created to support the Municipality of Genova with actions of social research, planning, consulting, technical assistance and transfer of methodologies in the field of management of human resources, local development, support to entrepreneurship. Therefore, the company participates in RAISE on behalf and on mandate of the Municipality of Genova. Job Centre has carried out activities of technical and methodological coordination, development, definition and governance of local development plans in order to create economic growth and to promote territorial marketing. It has also contributed to the planning and management of diffuse incubators in order to support the ability of companies to rejuvenate the territory. In this sense, it also supports the public administration in the definition and provision of funding for call for tenders addressed to SMEs and innovative start-ups.

Furthermore, Job Centre has been an accredited as tutor of the National Microcredit Agency for the area of the Metropolitan City of Genova since 2018. Among the activities promoted, it is worth mentioning: the promotion of economic support and tutoring opportunities to microenterprises and professionals; the launch of activities of study, research and engineering of new solutions; the promotion of financial education; the development of entrepreneurial culture, solidarity principles and profit ethics.

Finally, Job Centre is the managing subject of the Genova Blue District, which aims at supporting the vocation of Genova as a leader in the blue economy. In this regard, it dynamizes the convergence between local processes and scientific, technical and entrepreneurial resources for the creation of skills, research, technology transfer, green and digital driven innovation in the blue economy.

### ***2.3 Level and intensity of the proposed or existing national and international research collaborations of each participant in relation to the themes and objectives of the research and innovation program***

One of the criteria that guided the choice of the ecosystem components was the level and intensity of collaborations at national and international level and the participation to networks, associations and clusters on the topics of Robotics and Artificial Intelligence with applications in the fields of RAISE.

Many of these collaborations involve several ecosystem participants that collaborate permanently in these fields by sharing personnel and infrastructures, also through joint labs located in Liguria, which will be made available to the RAISE ecosystem.

In the descriptive sheets of each participant (see previous section) the main and most relevant collaborations are included.

In the following, the most relevant collaborations are reported, both from the scientific point of view and in terms of the ability to generate new opportunities for ecosystem relations with national and international institutions, and which see the involvement of many RAISE members.

- 1) RoboIT is the first of the National Technology Transfer Hubs dedicated to Robotics (which is one of the 4 IIT research domains). It aims to support the emergence of new start-ups created within universities and leading research centres, with an initial endowment of around 10 M € from CdP (Cassa Depositi e Prestiti). Among the other Scientific Partners of this initiative are the University of Naples Federico II, the University of Verona and the Scuola Superiore Sant'Anna in Pisa. RoboIT will be officially launched in May 2022.
- 2) The National Research Council promotes the Italian National PhD Program in Artificial Intelligence (<https://www.phd-ai.it/>) made of 5 federated PhD courses that bring together 61 universities and research institutions. The 5 PhD courses share a common basis in the foundations and developments of AI, and each one

has an area of specialisation in a strategic sector of AI application (Health and life sciences, agri-food and environment, security and cybersecurity, industry4.0 and society). Each PhD course is organized by a lead university, in collaboration with the National Research Council CNR.

- 3) SOFTMANBOT (Advanced Robotic Technology for Handling Soft Materials in Manufacturing Sectors - H2020-NMBP-FOF-2019 RIA GA869855 2019-23) - <https://softmanbot.eu/>
- 4) SOFTMANBOT is an industrial-end-user driven project that will provide an innovative and holistic robotic system for the handling of flexible and deformable materials within labour-intensive production processes.
- 5) DIGITAL INNOVATION HUBS in HEALTHCARE ROBOTICS (DIH-HERO) - <https://dih-hero.eu/>
- 6) DIH-HERO is an independent platform which connects Digital Innovation Hubs across Europe to create a sustaining network for all those who are active in the healthcare robotics sector.
- 7) The project consortium consists of 17 core partners spread across 11 pan-European countries.
- 8) Competence Centre START 4.0 ([www.start4-0.it](http://www.start4-0.it)) Led by the Italian National Research Council (Consiglio Nazionale delle Ricerche, CNR), the Association involves a wide span of more than 36 entities among public bodies (Italian Institute of Technology and Port System Authorities at the helm) and private companies, from large multinational (among which Leonardo, Fincantieri, Ansaldo Energia), to SME (e.g. Aitek, EttSolutions) . START 4.0 is one of the 8 highly specialized Competence Centres promoted by the Italian Ministry of Economic Development (MISE) to facilitate Industry 4.0 enabling technologies adoption, with a particular focus on the security and optimization of strategic infrastructures.
- 9) Digital Innovation Hub Liguria (<http://www.dihliguria.it/>) is an Association established in Genoa by Ligurian associations (Founding members) of the Confindustria System.
- 10) Digital Innovation Hub Liguria is also supported (Supporting members) by public and private entities united by the common desire to promote the digital transformation of companies, in particular those located in Liguria.
- 11) At the national level, DIH Liguria is part of the Confindustria DIH network created to support the digital transformation and innovation processes of Italian companies. At the European level it is part of the DIH network promoted by the European Union to pursue a territorial innovation ecosystem.
- 12) EIT Digital: (<https://www.eitdigital.eu/>) leading European digital innovation and entrepreneurial education organisation driving Europe's digital transformation. Its way of working embodies the future of innovation through a pan-European ecosystem of over 200 top European corporations, SMEs, start-ups, universities and research institutes, where students, researchers, engineers, business developers and entrepreneurs collaborate in an open innovation setting.
- 13) SoBigData (<http://project.sobigdata.eu/>) proposes to create the Social Mining & Big Data Ecosystem: a research infrastructure (RI) providing an integrated ecosystem for ethic-sensitive scientific discoveries and advanced applications of social data mining on the various dimensions of social life, as recorded by "big data". The Consortium consists in 12 core partners spread across 7 European countries.
- 14) CNR, IIT and UniGe are nodes of the CINI Artificial Intelligence and Intelligent Systems National Laboratory (more than 60 research institutions involved).
- 15) CLAIRE (<https://claire-ai.org>): CNR, IIT and UniGe are partner of CLAIRE Research Network, Confederation of Laboratories for Artificial Intelligence Research in Europe formed by 437 labs and institutions. The CLAIRE labs are committed to working together towards realising the vision of CLAIRE: European excellence across all of AI, for all of Europe, with a human-centred focus. Over 24,000 people work for the groups and institutions that form the CLAIRE Research Network in 37 countries (properly accounting for overlap between groups).
- 16) EU-ROBOTICS (<https://www.eu-robotics.net/>): euRobotics AISBL is a Brussels based international non-profit association for all stakeholders in European robotics. It was founded in September 2012 with the aim to strengthen Europe's competitiveness and to ensure industrial leadership of manufacturers, providers and end-users of robotics technology-based systems and services.
- 17) The objectives of euRobotics are to boost European robotics research, development and innovation and to foster a positive perception of robotics.
- 18) ELLIS, European Laboratory for Intelligent Systems - <https://ellis.eu/> The European Laboratory for Intelligent Systems is a network of European units whose mission is to promote the best basic research in machine learning in Europe.
- 19) Public Research Organizations involved in RAISE are members of NETVAL Association ([www.netval.it](http://www.netval.it)): Netval is a recognized Association that gathers 64 Universities, 15 Public Research Institutions (EPR), 13 Scientific Institutes (IRCCS), 3 foundations, 2 agencies and an association. Its mission is the enhancement of public research, which takes place also and above all through the creation of a community of professional Technology Transfer Managers

20) Many of the entities that join RAISE are also actively involved in the National Technological Clusters funded by MUR, such as "Blue Growth", "Smart Factory", "Life Sciences", "Technologies for Smart Communities".

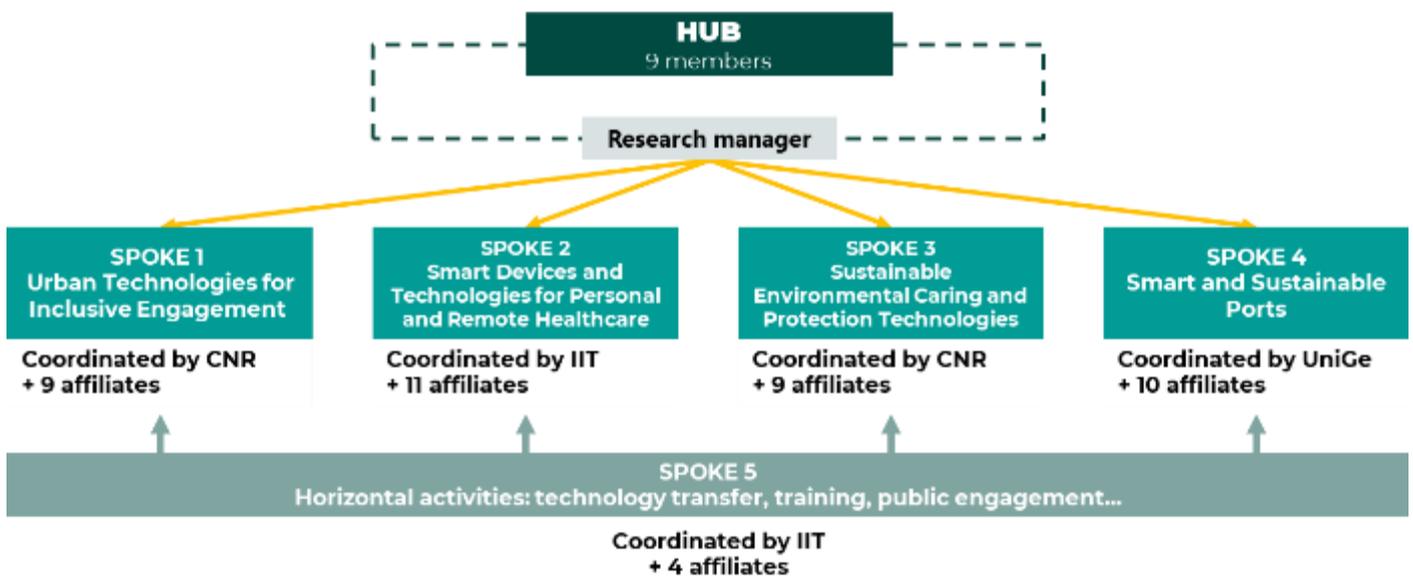
The scope and breadth of these collaborations (which numbered over 1,000 entities including research institutions, companies and other organisations) will be capitalised on through the creation of a Digital Community Valorisation Platform, that allows to register, store, manage and orchestrate the key elements of the ecosystem and its network of national and international relationships.

### 3 CHARACTERISTICS, FEASIBILITY AND CONTROL

#### 3.1 Composition of the critical mass that will be involved in carrying out the research and innovation program

##### 3.1.1 n. of Spoke and n. of affiliates with the Spoke identified, selection procedures and the reason for choosing the Spoke and affiliates, for the purpose of consistency with the aims of the research and innovation program

As illustrated in the following figure, RAISE includes 5 Spokes: (i) Spoke 1 on Urban technologies for inclusive engagement, led by CNR, (ii) Spoke 2 on Smart devices and technologies for personal and remote healthcare, led by IIT, (iii) Spoke 3 on Sustainable environmental caring and protection technologies, led by CNR, (iv) Spoke 4 on Smart and sustainable ports, led by UniGe, and finally (v) Spoke 5 on Technology transfer and public engagement, led by IIT. The first four Spokes are thematic as they focus on specific areas of research. To the contrary, the fifth Spoke is to be considered as horizontal, as it will act as a catalyst for all technology transfer-relates activities of all the other Spokes.



The thematic areas of the first four Spokes were selected through the combination of top-down and bottom-up approaches. Already in December, before the publication of the public notice calling for proposals for ecosystems of innovation, UniGe, CNR and IIT organised a series of meetings with their leading researchers in the fields of robotics and AI, in a view to identify possible thematic areas of research. Building upon the current areas of excellence of the entire Region and its research entities (for a more detailed account of the consistency between the regional specialisation and RAISE, please refer to Section 1), they laid down draft names, narratives, and research streams of the Spokes. After that, a series of workshops open to all interested entities were held, with the aim of collecting applications to join the ecosystem, while at the same time refining the five Spokes. In addition to this, bi-lateral interactions between the three Spoke coordinators and all potential affiliates were held in order to select those candidates characterised by relevant previous experiences, the capacity to commit the required number of resources, and the capacity to co-fund the ecosystem and guarantee its sustainability also after 2026. The following table lists all the members of RAISE.

#	Subject	Hub	Spoke 1	Spoke 2	Spoke 3	Spoke 4	Spoke 5
1	UniGe	X	X	X	X	X*	X
2	CNR	X	X*	X	X*	X	X
3	IIT	X	X	X*	X	X	X*
4	AFS						X
5	Aitek					X	
6	algoWatt				X	X	
7	ANCI Liguria	X					
8	Ansaldo Energia				X		
9	CIMA	X			X		

#	Subject	Hub	Spoke 1	Spoke 2	Spoke 3	Spoke 4	Spoke 5
10	Circle					X	
11	EII		X	X		X	
12	ENEA				X	X	
13	Esaote			X			
14	ETT		X		X		X
15	FDG		X	X			
16	FILSE	X					
17	Fincantieri					X	
18	FISM		X	X			
19	Galliera		X	X			
20	Gaslini		X	X			
21	HSM		X	X			
22	INFN					X	
23	Info Solution				X		
24	INGV				X		
25	Job Center	X					
26	Leonardo					X	
27	Liguria Digitale	X					
28	Movendo Technology			X			
29	Philips			X			
30	Regione Liguria	X					
	<b>Total</b>	<b>9</b>	<b>10</b>	<b>12</b>	<b>10</b>	<b>11</b>	<b>5</b>

Note: X\* indicates the spoke coordinator

### 3.1.2 n. of overall human resources employed to carry out the activities of the research and innovation program, with the breakdown by single Spoke and affiliates; indication of the selection methodology, which guarantees the involvement of the best skills in the national and international context

The total number of human resources involved in the RAISE ecosystem is 644 distributed as follows:

Subject	Total CV by subject	Spoke 1	Spoke 2	Spoke 3	Spoke 4	Spoke 5
UniGe	168	38	53	40	48	30
CNR	142	31	29	59	26	23
IIT	90	17	43	12	20	18
AFS	7					7
Aitek	7				7	
AlgoWatt	7			7	7	
Ansaldo Energia	7			7		
CIMA	8			8		
Circle	8				8	
EII	21	10	10		10	
ENEA	16			16	9	
Esaote	20		20			
ETT	21	7		8		7
FDG	13	8	8			
Fincantieri	8				8	
FISM	14	10	13			
Galliera	7	7	7			
Gaslini	14	7	7			
HSM	17	8	9			

INFN	7				7	
Info Solution	8			8		
INGV	11			11		
Leonardo	7				7	
Movendo Technology	9		9			
Philips	7		7			
<b>Great total</b>	<b>644</b>	-	-	-	-	-
<b>Total CV by spoke</b>	-	<b>143</b>	<b>215</b>	<b>176</b>	<b>157</b>	<b>85</b>

*Note: The totals by subject and the great total do not correspond to the sum of the number of CV by spoke as certain experts are envisaged to be involved in more than one spoke.*

Following the selection procedure of the SPOKE affiliates, coordinated by the HUB founders, the coordinators of the single SPOKES have been designated, chosen on the basis of the scientific quality expressed in the reference sectors and on the basis of the experience in the coordination of complex projects also at international level. The SPOKE coordinators asked their own organisation and affiliates to identify the best skills to be included in the RAISE ecosystem.

The choice of the best competences was made according to the following criteria. For personnel to be involved in research and development projects: scientific quality proven by high bibliometric indicators, experience in coordinating projects at national and international level, experience in research and development activities conducted in collaboration with companies, coordination and participation in projects with high economic and social impact. All these criteria have been assessed with reference to the specific technological field of RAISE (robotics and artificial intelligence). For the staff to be employed in "transversal" activities such as technology transfer, public engagement, outreach and training: at least ten years of national and international experience in the reference sectors, coordination/participation in complex projects in the reference sectors with particular attention to public/private partnership initiatives, participation and management of national and international networks on the reference themes.

In all cases, the selection took into account "transversal" criteria such as gender equity (over one third of those involved are women) and the participation in the ecosystem of researchers who have obtained their PhD less than 10 years ago (nearly 20% of the experts proposed by UniGe, CNR and IIT).

The HUB then evaluated and validated the proposals of the SPOKE coordinators, verifying compliance with the above criteria.

### ***3.2 Management and administrative structure proposed; evidence of the management and coordination skills of the Hub***

In RAISE, the HUB plays a crucial role in terms of guidance, management and control. For this reason, the choice of the HUB Founders has taken into account the need to implement a management and administration structure capable of guaranteeing, thanks to its own internal resources, all the functions necessary for a correct realisation of the programme both in terms of effective implementation of the activities and of correct execution in administrative terms.

The HUB, constituted in the form of a Consortium, will identify a management body (Board of Directors), which will be responsible for the validation of the activities and costs incurred by the SPOKES, for the evaluations on possible proposals of variations with respect to the deliberated budgets, for the constant monitoring of the progress of the activities with respect to the scientific and spending objectives. The Board of Directors will consist of 5 persons, designated by the members and composed of people with many years of experience in the management of public-private partnerships, complex projects financed by public resources and proven planning and control skills.

The HUB statute will also identify an Advisory Board with strategic guidance functions which, as mentioned above, will be composed of representatives of the Ligurian research and innovation system and which, under the coordination of Regione Liguria, will ensure the complementarity of RAISE actions with existing initiatives or those in the start-up phase (ERDF OP, ESF OP).

The governance of the HUB will be completed by a Scientific Committee composed of international experts in the field of Robotics and Artificial Intelligence with the task of promoting and directing the positioning of the ecosystem in the national and European panorama and of building a medium-long term vision of RAISE. The Scientific Committee will

be in charge of proposing to the Board of Director a five-year plan (RAISE Strategic Plan) that combines the development and research lines envisaged in the present proposal with further trajectories of strengthening and growth.

As foreseen, a research manager will be selected with general co-ordination functions, who will be supported by a stable team (Project Management Office), with support functions to the SPOKE in order to guarantee the correct management of the resources (timing, eligible costs, reporting modalities) and the correct application of the reference regulations (state aid regulation, procurement regulation). To this end, the support team will involve specialised staff working in the public founders of the HUB and experienced in the management of funded projects, procurement procedures for the acquisition of goods and services.

A further support function to the SPOKES concerns the definition and management of calls for financing of subjects outside the ecosystem. The presence of the Region with its in-house FILSE and Liguria Digitale will guarantee the presence in the team of personnel with many years of experience in the management of programmes and calls for tenders within the framework of the European Structural Funds and in the development of digital platforms for the submission of projects and for the management of the evaluation and monitoring phases. The team will be complemented with technologists experienced in the management of research programmes, technology transfer, collaboration development, research and impact assessment processes, etc.

As required by the MUR call, the ecosystem structure was chosen in order to concentrate in the HUB programming, project management, monitoring, management control and governance skills for the entire ecosystem; the connection between the HUB and the SPOKES is guaranteed by the presence in the HUB of UniGE, CNR and IIT (which are also SPOKES); the Affiliates were selected through a call for expressions of interest, evaluating the specific skills of each subject in technological and scientific terms to actively contribute to the project tasks as illustrated in Section 3.4.1.

### 3.3 Operational units (e.g. institutes, departments, centres, laboratories, operational offices) to be involved in the development of the activities

Entity	Institute/Laboratory	S1	S2	S3	S4	S5
CNR	DIITET - Department of Engineering, ICT and technologies for energy and transportation.		X			
CNR	DSFTM - Department of Physical Sciences and Technologies of Matter		X			
CNR	EU – Marine Robots				X	
CNR	IAS - Institute for the Study of Anthropic Impact and Sustainability in the Marine Environment			X	X	
CNR	IBF - Institute of Biophysics		X	X		
CNR	ICMATE - Institute of Condensed Matter Chemistry and Energy Technologies of the DSCTM (Dept. Chemical Sciences and Materials Technologies)		X	X		
CNR	IEIIT - Institute of Electronics, Computer and Telecommunication Engineering	X	X			
CNR	IFC - Institute of Clinical Physiology of the DSB (Dept. of Biomedical Sciences)		X			
CNR	ILC - Institute of Computational Linguistics	X	X		X	
CNR	IMATI - Institute of Applied Mathematics and Information Technologies	X	X	X		
CNR	IMEM - Institute of materials for electronics and magnetism	X	X			
CNR	INM – Institute of Marine Engineering			X	X	
CNR	IRCrES – Research Institute on Sustainable Economic Growth	X			X	
CNR	IRPPS – Institute for Research on Population and Social Policies of the DSU		X			
CNR	ISMAR – Marine Science Institute			X	X	
CNR	ITC - Institute for Construction Technologies	X				
CNR	ITD – Institute for Educational Technology	X				
CNR	SCITEC - Institute of Chemical Sciences and Technologies		X	X		
CNR	SPIN - Institute for Superconductors, Oxides and Other Innovative Materials and Devices		X	X		
IIT	ADVR – Advance Robotics Research (XoSoft, VICARIO Labs)				X	
IIT	AMI Lab – Artificial and Mechanical Intelligence				X	
IIT	APRIL - Active Perception and Robot Interactive Learning laboratory				X	
IIT	Communication and Media Directorate					X
IIT	DLS – Dynamic Legged System				X	
IIT	EDL – Electronic Design Laboratory	X				
IIT	Franklin HPC				X	
IIT	HRI2 – Human-Robot Interfaces and Physical Interaction				X	
IIT	IF (URI, RAIN Labs)				X	
IIT	INAIL Biomedical Robotic Lab				X	
IIT	INAIL ROBOT TELEOPERATIVO				X	
IIT	Industrial Robotic Facility				X	
IIT	JOiINT LAB				X	
IIT	MW				X	
IIT	PAVIS – Pattern Analysis and Computer Vision				X	
IIT	PerGenova				X	
IIT	RAIN – Robotic Automation INspection Lab				X	
IIT	RBCS – Robotics Brain and Cognitive Sciences				X	
IIT	SRHCR				X	

Entity	Institute/Laboratory	S1	S2	S3	S4	S5
IIT	Technology Transfer Directorate					X
IIT	VICARIO				X	
Leonardo	Techno-laboratories for children					X
UniGe	Bioengineering Lab		X			
UniGe	Casa Paganini		X			
UniGe	CEDRO			X	X	
UniGe	CEF FENIX				X	
UniGe	Center of the sea					X
UniGe	CENVIS - Centro di servizi per il Ponente ligure			X		
UniGe	CIELI/DIEC - Logistics and Maritime Observatory				X	
UniGe	CIPI Lab for Yacht Safety				X	
UniGe	DCCI – Department of chemistry and industrial chemistry			X		
UniGe	DIBRIS – Department of Informatics, Bioengineering, Robotics and Systems Engineering			X	X	X
UniGe	DICCA - Department of Civil Engineering		X	X	X	
UniGe	DIEC – Department of Economics				X	X
UniGe	DIFI – Department of Physics			X		
UniGe	DIGI - Department of law					X
UniGe	DIME - Department of Mechanical Engineering		X	X	X	
UniGe	DIMES – Department of Experimental Medicine		X			
UniGe	DIMI - Department of Internal Medicine and Medical Specialties		X			
UniGe	DINOEMI – Department of Neurology, Neuroimaging, Rehabilitation		X			
UniGe	DISC - Department of Integrated Surgical and Diagnostic Sciences		X			
UniGe	DISFOR - Department of education sciences					X
UniGe	DISPO - Department of political science					X
UniGe	DISSAL - Department of Health Sciences		X			
UniGe	DISTAV - Department of Earth Sciences, Environment and Life Sciences				X	
UniGe	DITEN – Department of Electrical, Electronics and Telecommunication Engineering and Naval Architecture			X	X	
UniGe	DITEN - Electronics, Networks and Communications, Electromagnetic fields		X	X		
UniGe	DruidLab				X	
UniGe	EMARO - Lab		X		X	
UniGe	Hadoop/Spark/SparkML				X	
UniGe	Industrial Robotic Facility				X	
UniGe	ISME – Interuniversity Center of Integrated Systems for the Marine Environment			X	X	
UniGe	Laboratorium		X		X	
UniGe	LisComp Lab - Life Science Computational Lab		X			
UniGe	LLA – Lifelong Learning Area					X
UniGe	MAC Lab		X			
UniGe	MalGA Lab -Machine Learning Genoa Center		X		X	X
UniGe	MeteOcean				X	
UniGe	MIDA - Department of Mathematics		X			
UniGe	RASES - Interuniversity Research Center on Robotics and Autonomous Systems in Emergency Scenarios			X	X	
UniGe	Research infrastructures and Energy Management tools for the Smart Polygeneration Microgrid and the Smart Energy Building				X	
UniGe	ROBINS - ROBOTics technology for INSpection of Ships				X	
UniGe	Sea LAB - Smart Embedded Application Laboratory				X	
UniGe	Security, Risk and Vulnerability Center					X
UniGe	ShIL Lab				X	
UniGe	SimAy - Center of Advanced Simulation		X			
UniGe	SIOT - Smart Internet and IoT				X	
UniGe	Transport Systems Engineering lab				X	
UniGe	TTLab – Technology Transfer Laboratory					X
UniGe	UniWeLab				X	
UniGe	UTLC – UniGe Teaching and Learning Centre					X
UniGe/CNR	Blue-Lab NET				X	
UniGe/IIT	ELLIS - European Laboratory for Learning and Intelligent Systems				X	
UniGe/IIT	EURObench Facility				X	
UniGe/IIT	XoLab				X	

### 3.4 Feasibility of the work plan, providing elements that ensure its feasibility and set up in relation to the deadlines of the plan

As highlighted in the previous section, the ecosystem is built upon a well-established network of existing and fully operational institutes, centres and laboratories. This condition will allow an immediate launch of all work packages and the development of the initial activities. The RAISE Calls for PoC and cascade fundings will allow RAISE to further improve its infrastructures through the purchase of instrumentations for the establishment, start-up, and/or consolidation of joint facilities, laboratories, and joint labs. To support RAISE research, development, and training activities, and animate the RAISE laboratories and joint labs, the Hub will also launch (as envisaged in the milestone plan) a significant recruitment programme for young researchers.

In the following, we provide a list of the main objective and milestones of each RAISE spoke, which address the set-up of the main RAISE activities with respect to the RAISE Workplan.

**For Spoke 1, the main objectives and milestones are**

- M5-M16 - Pilot selection, design, and planning. Urban Data Platform set-up. Data, models, and software for skill quantification and well-being analysis.
- M17-M28 - First pilot phase; integrating and testing prototypes in urban settings. First validation phase; impact assessment and feedback.
- M29-M36 - Second pilot phase; refinements of products and experimental sessions in urban settings. Final validation phase; impact assessment and sustainability analysis. Documented portfolio of sensors, devices, and interaction systems. Living Lab sustainability plans.

**For Spoke 2, the main objectives and milestones are**

- M5-M16 - Design and implementation of platforms and infrastructures for intelligent environments and for digital twins at multiple scales. First prototypes of assistive and rehabilitation devices and new AI-based imaging tools and technologies.
- M17-M28 - First prototypes of intelligent environments, digital twins at multiple scales and data-driven and knowledge-driven solutions for clinical workflow. Assistive and rehabilitation devices in relevant scenarios.
- M29-M36 - Deployment of Intelligent environments in domestic settings. Application of digital twins at multiple scales in clinical scenarios. Deployment and test of rehabilitation platforms in clinical and home settings. The transition of platforms for diagnostic and interventional imaging toward commercial products

**For Spoke 3, the main objectives and milestones are**

- M5-M16 - Start-up of joint labs between Spoke and Affiliates. Setup of field labs. Deliverables of R&D activities of WP 1-5 (technical reports). Lab validation of methodologies and technologies.
- M17-M28 - Start-up of field labs. Deliverables of R&D activities of WP 1-5 (technical reports).
- M29-M36 - Deployment and application in lab and on-field of methodologies and technologies

**For Spoke 4, the main objectives and milestones are**

- M5-M16 - Start-up of joint labs between Spoke and Affiliates. Setup of port labs. Algorithms and tools for port automation and port asset management; tools and devices for collecting data in port areas, algorithms and tools for data analysis; algorithms and tools for freight management, data sharing and collaborative analytics, energy efficiency, transport network optimization, disruption management; tools and services for tourism and recreational boating.
- M17-M28 - Start-up of port labs. Hardware prototypes for inspection of port infrastructures, monitoring, and process automation; hardware and software prototypes for traffic monitoring, nowcast and forecast of marine conditions, sustainability and risk assessment, predictive maintenance of port infrastructures, pollution and natural resources monitoring; detection systems for port protection and early warning systems; software prototypes for port management.
- M29-M36 - Deployment and application of autonomous systems (terrestrial robots, marine and underwater vehicles, aerial systems), AI-based data collection and analysis, simulation tools (digital twins and virtual models) and decision support systems in port areas and touristic port environments.

**For Spoke 5, the main objectives and milestones are**

***Ecosystem Identity, communication and outreach***

- M1-M5 – Ecosystem Identity (1): Marketing, Communication and outreach Plan Adoption, Brand Identity, RAISE Channel Communication Design and Implementation, First RAISE Annual Meeting (kick off)
- M7-M36 - Ecosystem Identity (2): Outreach, dissemination, public engagement, Community Development and business development

### *Open Innovation and open data platform*

- M4-M10 - Open Innovation & Open Data Platform (1): Design and implementation of an open innovation and open data platform to connect spokes, define a process performance standard, monitor spoke performance, release open data and ecosystem results, open call management
- M11-M36 - Open Innovation & Open Data Platform (2): Platform management and governance

### *Open call for accelerator grants*

- M4-M8 – Open call (accelerator grants) first wave: Publication of the calls for Accelerator Grants first wave (Start-Up Grants and Scale-Up Grants) and selection of recipients (ranking)
- M12-M16 – Open call (accelerator grant) second wave: Publication of the calls for Accelerator Grants second wave (Start-Up Grants and Scale-Up Grants) and selection of recipients (ranking)
- M18-M22 - Open call (accelerator grant) third wave: Publication of the calls for Accelerator Grants third wave (Start-Up Grants and Scale-Up Grants) and selection of recipients (ranking)

### *Technology transfer activities*

- M7-M18 - Technology transfer and exploitation of research results - Phase 1: Feasibility studies, market studies, definition of strategies for the protection and exploitation of intellectual property, acceleration and incubation plans for business ideas, Training Strategy Plan and Implementation RoadMap, Delivery
- M19-M30 - Technology transfer and exploitation of research results - Phase 2: Feasibility studies, market studies, definition of strategies for the protection and exploitation of intellectual property, acceleration and incubation plans for business ideas, Training Strategy Plan and Implementation RoadMap, Delivery
- M31-M36 - - Technology transfer and exploitation of research results - Phase 3: Feasibility studies, market studies, definition of strategies for the protection and exploitation of intellectual property, acceleration and incubation plans for business ideas, Training Strategy Plan and Implementation RoadMap, Delivery

### *Education and training*

- M1-M6 – Training Plan adoption (1): Training needs analysis, Training Plan Development, contents for on line platform for education and training, on line catalogue for SMEs
- M8-M24 – Training Plan adoption (2): AI and Robotics Business Applications for SMEs, AI for Public Administration, Advanced and Robotics skills Master Degree, Basic AI and Robotics Skills for Secondary Schools and Higher Technical Institutes, Basic AI and Robotics Skills for Business, Vocation Training for Deep-Tech for Start-ups and SMEs, training for living and contamination labs, mentoring services for Phd students
- M25-M36 - Training Plan adoption (2): AI and Robotics Business Applications for SMEs, AI for Public Administration, Advanced and Robotics skills Master Degree, Basic AI and Robotics Skills for Secondary Schools and Higher Technical Institutes, Basic AI and Robotics Skills for Business, Vocation Training for Deep-Tech for Startup and SMEs, training for living and contamination labs, mentoring services for Phd students

The various actors involved also have a long-standing history of cooperation – and are currently involved in many relevant ongoing research projects – which will further facilitate the cutting of red tape and a rapid start of activities. Finally, thanks to the preliminary agreements that the Hub members have sealed with potential contributors to the ecosystem, the network of actors that will be essential for the successful functioning of the ecosystem can be considered de facto already largely in place and ready to contribute to the different streams of activity.

In addition to ensuring the conditions to guarantee a quick start, a dedicated Project Management methodology has been developed in order to efficiently run and timely complete the wide spectrum of activities foreseen throughout the planned 36 months of the programme, tailored to the complexity and scale of the Ecosystem. While the methodology is anchored and builds upon common international standards and best practices, it also presents distinctive and innovative features that have been tailored to address the specificities of the programme.

Under the supervision of the Advisory Board and the scientific guidance of the Scientific Committee, following the negotiation phase with the Ministry, the programme workplan will be defined, including milestones and targets and a

risk management plan. A continuous monitoring process will then be put in place to allow spoke leaders to report on their activities, flagging potential delays and risks. The programme manager – supported by the Project Management Office and a dedicated Risk Manager – will therefore be in a position to regularly track the advancement of all streams of activity, to timely identify potential risks, and to implement mitigation or corrective actions.

In line with PM best practices, all delays and risks will be registered in a Risk Log, which will further ensure their continuous monitoring and also facilitate reporting to other bodies, such as the Ministry itself. In addition to the constant monitoring of milestones and targets, a systematic review of scientific outputs will be conducted, under the responsibility of the Scientific Committee, which will coordinate the scientific efforts of the different spokes, provide technical guidance, and ensure the quality of the final results.

### *3.4.1 Work plan: activities that will be carried out as a whole and the respective costs for each legal entity; territorial distribution; roles and responsibilities of each entity involved; time schedule with the explanation of the main milestones to be achieved*

Building upon the overview of the research and innovation programme, of the five spokes and of their corresponding work programmes presented in the previous Section 2, the remainder of this section illustrates the specific tasks of each work package.

The budgets in the individual tables of each SPOKE correspond to the total costs of the programme including the mandatory (under the state aid regulation) co-financing of private partners (personnel and equipment). The total funding request is 120 million as stated in the project proposal document.

#### *3.4.1.1 Spoke 1 – Urban technologies for inclusive engagement (CNR, Michela Spagnuolo)*

##### **3.4.1.1.1 WP1 – FROM USER COMMUNITIES TO THE DESIGN OF INCLUSIVENESS (IIT, ALESSIO DEL BUE)**

**Task 1.1: Develop a reference knowledge and framework to design the sense of inclusiveness (IIT, all Partners).** Design thinking workshops with all relevant stakeholders, inside and outside the ecosystem, will be organized to determine the needs, identify use cases and elaborate solutions with a continuous iteration and interactions with mock-ups and early prototypes. The task will also consider the definition and implementation of Open Innovation tools to support knowledge sharing among the city stakeholders. Deliverable(s): Open Innovations tools to support Living Labs; Pilots selection; Guideline for pilot implementations (functional design of prototypes and pilot planning).

**Task 1.2: Quantitatively determining the individual state (IIT, CNR, UniGe, HSM, Galliera, Gaslini, FDG, FISM).** We will perform psychophysical sensory and motor, and emotional measurements associated with stimuli from different sensory channels to quantify, model, and classify the individual state in static and dynamic environmental contexts. We will obtain a quantitative definition of the “human state” and related model parameters and classification of measures/features extracted in different contexts. Deliverable(s): Guidelines for skill quantification and documentation; Experimental data sets.

**Task 1.3 Learning the individual state (IIT, CNR, UniGe, HSM, Galliera, Gaslini, FDG, FISM).** We will study machine learning methods that can learn from multiple users/subjects and in different contexts/scenarios, considering online and offline learning settings. Continuous streaming of multi-modal data (audio, sound, video, tactile, biometric and physiological data, etc.) will be collected and need to be processed in real-time and offline. We will aim to design predictive, interpretable, and efficient methods, addressing robustness and potential bias present in the data. Deliverable(s): Software for AI-driven skill quantification; Experimental data sets.

**Task 1.4: The Citizen Digital Twin (IIT, CNR, EII, HSM, Galliera, Gaslini, FDG, FISM).** Based on the outcome of Task 1.2 and 1.3, we will design a conceptual model (e.g., formal specification, machine-readable conceptualization) of the citizens, able to describe the abilities and expected reactions to the interaction with the urban context and individuals. This model will act as a Citizen Twin. It will represent a single point of access to government procedure, user data and interactions mechanisms, according to the WHEN-WHERE-FOR WHAT paradigm. It will increase the inclusiveness of a city by enabling more personalized services can react according to the person and in real-time to context changes. Deliverable(s): Conceptual model of the “perceived well-being” at the interface between individuals’ needs/skills and urban space state.

**Task 1.5 Definition of privacy preserving technologies for inclusive scenarios (EII, CNR, IIT, UniGe)** This task will define and provide a set of tools to support the compliance with GDPR whereas enabling personal data sharing for more inclusive urban scenarios. In particular, the task will provide tools for a dynamic consent management. This will

increase the perceived transparency among citizens and city service providers, by enabling citizen-centric data sharing processes. Deliverable(s): Policy and tools for privacy preservation.

**Task 1.6: Integrated design of the impact evaluation studies** (CNR, IIT, UniGe, HSM, Galliera, Gaslini, FDG, FISM). Definition of an evaluation framework to assess the impact of technologies and pilot demonstrators. The validation will include behavioral measures, questionnaires, and qualitative analysis. Combining these different measures will allow us to assess the solution's effectiveness and gauge users' impressions and opinions. Deliverable(s): Framework for the impact evaluation of the technology and pilots.

#### 3.4.1.1.2 WP2 – MAPPING AND COMMUNICATING URBAN WELL-BEING (CNR, ANTONIO PIEVATOLO)

**Task 2.1 Sensors and devices for micro-monitoring and for the analysis of indoor/outdoor spaces:** (CNR, IIT) Design and implementation of the network of sensors, mechanical and mechatronic technological systems, for real-time monitoring of indoor and outdoor micro-environmental variables (e.g. air quality, noise pollution, temperature/humidity and solar irradiation, vehicle and pedestrian flows) and user localization, especially those with specific needs through smart and minimal invasive personal devices such as smartphone/smartwatch. The sensors will use of 5G and 6G technology to enable fast, secure and massive data transfer from the network of sensors to the ICDL developed in the project. Deliverable(s): Report on the design and characterization of the sensor network for micro-monitoring and analysis of indoor/outdoor spaces and user localization.

**Task 2.2 3D semantic models of urban outdoor/indoor spaces:** (CNR, EII) – For the pilot areas defined in WP1, a detailed 3D acquisition of the area (eg. with LiDAR or photogrammetry) will be considered to define detailed 3D models of the areas, to be used as digital twins of the experimental physical context. Thanks to the data collected and managed by the Urban Data Platform (Task2.4) and the AI models defined (T2.3) will sustain the development of digital twin of the pilot areas. These digital twins will be semantically annotated with data/information derived from the wellbeing mapping services to provide a rich and dynamic view of the urban city state, and support evidence-based policy (see WP5). Deliverable(s): Software for 3D reconstruction and modeling and for the semantic annotation of urban space; Data collections.

**Task 2.3 AI-based data-driven characterization of the built urban space** (CNR) Assessment of acoustics, air quality, thermal and visual comfort of people in the built environment (indoor and outdoor), up to TRL5. Assessment and improvement strategies of air quality of indoor environment within naturally ventilated buildings based on the evaluation of mean age of air and on the air exchange as correlation of indoor and outdoor conditions. Empirical models (e.g. ML methods) will help classify user feedback and well-being, depending on the monitored environmental data, on surveys on the target population, developed by Task 4.4, and wearable data (see Task 3.1 “Sensors and devices for monitoring the health/physiological status”), as a support to AI-based prescriptions. Deliverable(s): Methods and software for the characterization of building; Data collections.

**Task 2.4 Definition of the Urban Data Platform (UDP) and dashboards** (EII, CNR) Design and development of the Inclusive Urban Data Space, for collecting and managing city sensor data, as well as data coming from heterogeneous systems already existing and running in the city. The design of the UDP will allow the harmonisation of collected data according to common data models based on well-known standards and ontologies, as ETSI NGSI-LD and SAREF, providing a uniform data access through Open APIs. Open APIs will allow both to access the data and the interoperability of the UDP with other platforms, such as the European Data Portal, supporting both the principles of Open Science and Open Data. This task also includes the design and development of visualization dashboard and visual analytics services for citizens, that will leverage the UDP and the Open APIs. The platform will be compliant with Minimum Interoperable Mechanism (MIMs) from Open and Agile Smart Cities. Deliverable(s): UDP Platform and services.

**Task 2.5: Mapping services for the community** (ETT, CNR, FISM) The state of the urban areas will be mapped onto the features that are expected to impact on the perceived sense of wellbeing. This mapping will be based on direct mapping, whether the correlation between environmental parameters on well-being is known or on learning, whenever the correlation is vague or unknown. Outcomes of the task will be: (i) services that can be offered to citizens, and tourists, that communicate the state of the city with respect to generic user categories, (ii) services that will communicate personalized mapping to specific users, (iii) services (or API) by which interaction devices and systems will be able to “know” the expected sense of perceived well-being during interactions. Deliverable(s): Multi-modal apps for personalized access to well-being city data.

#### 3.4.1.1.3 WP3 – TECHNOLOGIES FOR INCLUSION AND ENGAGEMENT (IIT, MONICA GORI)

**Task 3.1 Sensors and devices for monitoring the health/physiological status: (CNR, UniGe, FISM, FDG)** Development of wearable sensors and/or sensors integrated in the domestic environment, correlating ambient sensing measures towards a global assessment of fitness, wellbeing, and health for the continuous monitoring of the habits, conditions, and posture of frail individuals (elderly people or children). Deliverable(s): Innovative sensors.

**Task 3.2 Effective lexicons for smart technologies: (CNR, UniGe, FISM)** provides linguistic methodologies to support the creation of effective multi-modal glossaries, according to the type of users, to be used in WP interventions. Deliverable(s): Multi-modal lexicons.

**Task 3.3 Motor skills and Soft-Synergies for the study and identification of grasping (IIT, FISM).** We aim at defining a framework for the study of human motor abilities and grasping motions skills. We expect to obtain a set of tools to study and classify the performance of humans executing simple grasping actions, to extract factors such as the level of attention and tiredness that will be used to improve the qualification of the “human state” in typical atypical conditions. Deliverable(s): Methods and software to study grasping actions.

**Task 3.4: Development of multi-modal analysis tools (IIT, CNR).** We will develop methods to analyse continuous streams of multi-modal data (audio, sound, video, tactile, biometric and physiological data, etc.) that capture interaction sessions (in the Living Labs as well as in the field). Such large-scale and heterogeneous information must be interpreted and adapted to current contexts in order to extract models of behaviours, possibly correlated with the surrounding environment (where objects are? which is their function?). As the task will involve large, and possibly not annotated, corpuses of data, activities will develop unsupervised and self-supervised machine learning and computer vision approaches leveraging the multi-modal information from the sensory data of the living lab. Deliverable(s): Software for data analysis; Data collections.

**Task 3.5 Techniques for multimodal analysis of individual nonverbal behavior (UniGe, IIT, CNR-IMATI)** Design and implementation of solutions to monitor and adequately react to the physiological and affective state of people during human-device and human-human interaction. The focus will be on: (i) bodily-based messages (such as gaze, facial expressions, movement style) and on (ii) interface-based messages (such as force, pattern of touches or time used to press on a touch screen or on a keyboard). The solution, implemented on devices as interfaces and toys for intergenerational communication, will estimate factors such as the engagement and comfort level of the users, while monitoring their interaction dynamic. The comprehension of these properties will also leverage on the knowledge of the environmental context and the “urban state” in which the device is embedded. To properly steer and facilitate the interaction, the development will maximize the transparency and adaptiveness of the device response. Deliverable(s): Software and devices for interaction analysis; Data collections.

**Task 3.6 Design and prototyping of electronic, mechanical, and mechatronic technological systems. (IIT)** We will develop brand-new mechatronic devices supporting the interaction and the analysis of sensory-motor data for the prototype evaluation. This task encompasses constraint definition and system architecture, design of the electronic components and subsystem in tight relationship with mechanical design (embedded system), production and testing of prototypes. Deliverable(s): Mechatronic devices.

**Task 3.7 Multimodal interaction and communication methods and technologies (UniGe, IIT, ETT)** based on VR/AR/XR techniques and/or social robots for translating information between sensory modalities (e.g., sonification) and novel sensorized materials to foster universal experiences. Cross-modal approaches, including interactive sonification of individual behavior, can contribute to the design of urban soundscapes aiming to improve citizens' quality of life and wellness in an art-inspired cultural wellness scenario. Deliverable(s): Methods, devices, and software for interaction design.

#### 3.4.1.1.4 WP4 – URBAN TECHNOLOGIES IN PLACES: EXPERIMENTATION AND VALIDATION (UNIGe, GUALTIERO VOLPE)

**Task 4.1 Pilot planning (CNR, all Partners).** For each of the case studies, a detailed action plan will be defined including a preliminary analysis of the normative and technical requirements related to safety and security. Risk analysis and timely delay recovery plans to ensure a successful completion of the experimental phase. Deliverable(s): Pilot implementation plan and monitoring.

**Task 4.2 Field-testing and validation for outdoor interaction and inclusion (IIT, all Partners).** Two actions will be carried out. The first action is for inclusion in the game: experimentation in the field and validation of an integrated ecosystem of interactive games (sensorized and mechanically adequate) and optimization of user parameter detection (e.g. child with visual and motor disabilities and development of a smart recreation area). The second action is for the

inclusion in the mobility of impaired people in the urban environment (e.g., visual impairment and schizophrenia/bipolar). We will develop a system based on computer vision and multisensory feedback to guide the user and detect his perceptual state and efficiency in interacting with the environment (e.g., in buses/public transport or city journeys). We will evaluate the emotional parameters of the user environment. Deliverable(s): Pilot report and validation report; physical and digital installations.

**Task 4.3 Field-testing and validation for indoor interaction and inclusion (IIT, all partners)** This work consists of the implementation and validation of a multimodal adaptive system (AR/VR/robotic interactive platforms) that dynamically adapt to the user's need and "human state" to promote learning dynamic and individualized feedback will be provided in individual and group activities. Deliverable(s): Pilot report and validation report; physical and digital installations.

**Task 4.4 Mapping the needs, assessing the outcomes (CNR, all Partners)** We will manage the monitoring and evaluation of the pilot experimentations, in close collaboration among the whole spoke team. This activity will include the assessment of the entry and exit levels of the participants and of the control group. The results of this activity will be used in-itinere for the fine-tuning of the experimentations and ex-post for a final judgment on effectiveness. Metrics and measurement systems will be jointly designed with the other teams. Validated questionnaires and ad-hoc surveys on environmental perception, will also be considered according to the basic principles of semantics and environmental comfort regulations. Subsequently, questionnaires built on objective scales concerning environmental factors (thermal, acoustic, visual and air quality environments) will be administered to groups of people in relevant environments. Deliverable(s): Report on the impact assessment.

#### 3.4.1.1.5 WP5 – FROM INCLUSIVE TECHNOLOGIES TO INCLUSIVE SMART CITIES (UNIge, PAOLA RENATA DAMERI)

**Task 5.1 Creating interoperability and open data to facilitate the creation of AI models and solutions in local PA (UniGe, EII).** This task aims to define data models for local public bodies, with high interoperability and openness, to support AI software development and pilot implementation of new applications and tools for evidence-based governance and tailored services. The task will leverage and evolve ICT tools for the exploitation of territorial Open Data following European standards (i.e., DCAT-AP). Deliverable(s): interoperable and open datasets; PA data models; data collection.

**Task 5.2 Developing AI solutions and strengthening AI skills for the local authorities (UniGe, EII).** AI applications and algorithms based on supervised and unsupervised machine learning methods for processing and analyzing heterogeneous, structured, and complex information that guide the development of services for the citizen. These tools should be reusable and addressed to both administrative processes simplification and improvement and AI supported local policies. AI potentialities are linked to the process of digitalisation regarding the PA. However, digital skills in PA are very low (EU Commission survey, 2020) and ad-hoc education programs are needed to permit an effective adoption of AI tools in all the administrative and political processes. Deliverable(s): AI solutions for supporting customized service design; educational activities for both public officials and local politicians.

**Task 5.3 PA-citizens interaction and citizens' engagement. (UniGe)** Implementing AI methods for creating, visualizing and communicating structured and complex information for developing citizen-centred communication services. For example, to develop interfaces based on opinion analysis and detection and prediction of critical points in processes to identify possible solutions. Deliverable(s): Urban platform for PA-citizens interaction.

**Task 5.4 - Identification of design-driven solutions for urban regeneration strategies (UniGe).** Design and integration of low-impact assistive smart technologies, including assistive housing models, to easily intervene on the existing/inhabited building stock and to facilitate the scalability/transferability of methods. The development of urban hubs to support networks of community services and indoor/outdoor smart interfaces will directly impact on the development of an inclusive community, the real-time monitoring, and the independence of people according to *life-time home* standards. Deliverable(s): Guidelines for urban regeneration strategies.

**Task 5.5 Assessing and evaluating economic and social outcomes and impact of AI adoption in local authorities (UniGe, CNR)** In a citizens' centred vision, AI adoption must produce public value, measured as both economic and social outcomes and impact. The present task aims to design and implement evaluation dashboards to measure the delivered public value and to assess the effectiveness of AI based policies. Deliverable(s): measurement models; measurement dashboards.

#### 3.4.1.1.6 WP6 - MANAGEMENT AND SPOKE SUPPORTING – (CNR, MICHELA SPAGNUOLO)

Beside these generic coordination activities, WP6 will act for:

**Task 6.1 Cascade funding (CNR, all Partners).** The plan for cascade funding is aimed at (i) **recruitment of young researchers** to train and specialize on the **multi-disciplinary skills** delineated by the Spoke theme. AI and Robotics are driving forces of the whole work programme, and their adoption in the specific spoke's domain opens a **wide range of opportunities and specialization directions**. (ii) call for participation opened to association of the **Third Sector** to involve actively in the Living Labs; (iii) services for the **set-up of the Living Labs** and their functioning, in terms of set-up of hardware and software, as well as services to facilitate the direct participation (eg. ad hoc mobility services); (iv) services to support **pilots field deployment** and testing, including service provision for **high-speed communication**.

**Task 6.2 Living Lab coordination and planning (IIT, all Partners).** Living Labs are an essential aspect of Spoke 1 and need to be set-up and engaged from the very beginning of the work programme. These are thought primarily as physical spaces, possibly distributed in urban areas with different characteristics (large and small municipalities), where virtual or physical prototypes will be made available for early experimentation and feedback gathering. The hardware setup will gradually evolve along with the evolution of the prototypes conceived, and the Living Labs are envisioned to become permanent structures in the territory to promote human-centred innovation.

**Task 6.3 Ethics, safety and privacy (HSM & IIT, UniGe).** The task will coordinate for all technical WPs the activities needed to properly handle ethical approvals and GDPR compliance along with the whole evolution of the Spoke 1 work programme. It will also manage the issues related to regulatory and procedural aspects mandatory to involve individuals in the experimentation of robotics and devices, possibly with the support of Spoke 5.

	<i>(in mln)</i>	<b>Cost</b>	<b>MUR Funding</b>	<b>Co-funding</b>
CNR (spoke)		<b>2,527</b>	2,527	0,000
IIT		<b>2,872</b>	2,872	0,000
UNIGE		<b>2,489</b>	2,489	0,000
ETT		<b>1,266</b>	0,681	0,586
ENGINEERING		<b>1,436</b>	0,826	0,610
SAN MARTINO		<b>0,494</b>	0,494	0,000
OSPEDALE GALLIERA		<b>0,412</b>	0,412	0,000
OSPEDALE GASLINI		<b>0,494</b>	0,494	0,000
DON GNOCCHI		<b>0,494</b>	0,494	0,000
FISM		<b>0,658</b>	0,658	0,000
<b>Total cost of spoke and affiliate spokes</b>		<b>13,141</b>	11,945	1,195
Cascade Funding for Recruiting		<b>1,685</b>	1,685	0,000
Cascade Funding for POC (Proof of Concepts)		<b>1,800</b>	1,800	0,000
Cascade Funding for Support Ecosystem (CFSE-R)		<b>1,000</b>	1,000	0,000
<b>Total Budget on Spoke 1 (in mln of euros)</b>		<b>17,626</b>	16,430	1,195

### 3.4.1.2 Spoke 2 - Smart Devices and Technologies for Personal and Remote Healthcare (IIT, Lorenzo de Michieli)

#### 3.4.1.2.1 WP1 – INTELLIGENT AND INTERACTIVE ENVIRONMENTS (IIT, MATTEO LAFFRANCHI)

**Task 1.1: Platforms and infrastructures.** Develop devices and architectures for IoT-based interactive environments intended for frail people in a domestic setting. These guidelines will consider current care practice and aspects of information handling, security, privacy, and platform scalability. **Deliverable:** Clear design criteria and architectures for distributed robotic systems.

**Task 1.2: AI-based interactive environments.** Set-up of intelligent and interactive environments, reconfigurable in accordance with the user clinical needs and capable of continuous health monitoring and providing assistance, also taking into account personalized solutions that adapt to different cultural background to address the multiethnicity of societies. Deliverable: Living labs monitoring system, including IoT sensors and/or assistive robots.

**Task 1.4: Case studies and experimentation in domestic settings.** Case studies involving people with different needs in assistance and health conditions. Deliverable: Demonstration that intelligent environments have a clear added value within the care context according to measurable indicators of Quality of Life (QoL) and global clinical improvement.

Principal participating institutions and key research infrastructures: IIT (Rehab Technologies, HSP, PAVIS, HRI<sup>2</sup>, Nanodiagnosics Lab, ADVR), UniGe (DIBRIS, DITEN, DINOEMI, DIMI, MaLGA, Casa Paganini), CNR (IMATI, IEIIT, SPIN, ILC), FISM (NeuroLab Facilities), FDG, Philips, EII, Galliera.

#### 3.4.1.2.2 WP2 – DIGITAL TWINS (UNI GE, MICHELA CHIAPPALONE)

**Task 2.1 – Enabling Technologies and platforms for Digital Twins.** We will create general platforms for the development of digital twins at individual patient level. Enabling technologies include: computational models and simulation environments; sensors and actuators; AI-based techniques to display Digital Twin state. We will target Digital Twins at multiple scales, from cells to tissue, to organs up to whole organisms and behaviours, including interaction with humans or devices. Deliverable: Devices and development environments for Digital Twins.

**Task 2.2 – Digital Twins for detection, diagnosis, and prognostics.** We will develop AI based Digital Twins capable of analysing patients' multiple parameters, comprising clinical and para-clinical outcomes, biomarkers, patient-related data, and medical procedures. This will support medical doctors to manage the complexity of multidimensional diseases, such as neurological and chronic conditions, contributing to an effective prediction of disease progression and treatment simulation. Deliverable: Implementation and validation of Digital Twins of patients at multiple scales.

**Task 2.3 – Interactive digital Twins for treatment and assistance.** The Digital Twins potential will be exploited through closed-loop connection with interactive technologies, including robotic and IoT devices. These real-time Digital Twins may support human-robot interaction in rehabilitation and assistive applications, robot-assisted surgery, brain-body and brain-brain dynamical interactions. These Digital Twins may predict how patient-technology systems can change over time. Deliverable: Implementation and validation of closed-loop Digital Twins of patient-environment interactions.

**Task 2.4 – Scaling up Digital Twins for industrial and clinical applications.** The activity aims at supporting the transition of Digital Twins from ad-hoc, bespoke scenarios to general industrial or clinical applications, embedded in specific devices or platforms. Coordination with Spoke 5 will assure the activation of conditions and actions to support the technology transfer process. Deliverable: Digital Twins for commercial applications.

Principal participating institutions and key assets: IIT (Rehab Technologies, PAVIS, NetS3, ADVR, NCSC, NetS3), CNR (IMATI, IEIIT, IMEM, SCITEC, IBF, CNR-UniGe Joint Lab on Movement Disorders), UniGe (DIBRIS, DICCA, DIME, DISC, DINOEMI, LiSComp Lab, MaLGA Lab, MIDA Group), HSM, IGG, Galliera, EII, Philips, FISM (NeuroLab Facilities).

#### 3.4.1.2.3 WP3 – REHABILITATION ECOSYSTEMS (UNI GE, VITTORIO SANGUINETI)

**Task 3.1 – Innovative devices and solutions.** Based on available technologies, we will develop novel assistive and rehabilitation solutions, suitable for home usage and with limited supervision. Ideally, devices will be low-cost; they will employ novel solutions for intention detection and control, based on modern human-robot interaction paradigms. Existing rehabilitation devices will be enhanced to achieve a more complete and integrated assessment and interaction with patients, including motor, cognitive and vestibular components. We will develop AI-based approaches for personalization of treatment, possibly involving Digital Twins and exergame solutions. Deliverable: Prototypes of rehab/assistive solutions.

**Task 3.2 – Clinical evaluation of proof-of-concept and market-ready devices.** Existing devices, robots, and platforms (either lab prototypes or commercial products) will be tested in a variety of new application scenarios, involving specific user populations (e.g., paediatric and multimorbid older adults) in both acute and chronic settings, with different types and degrees of neuromotor impairment. We will provide an initial evaluation of the technology in their application scenarios. Deliverable: Clinical qualification of devices in real environments.

**Task 3.3 – Transition of validated prototypes into commercial products.** Devices with a significant record of clinical use will be developed further to facilitate their evolution into commercial products. Coordination with Spoke 5 will assure innovation-related activities such as certifications, production engineering, compatibility with connected care platforms. Deliverable: Novel commercial solutions.

**Key facilities:** IIT (Rehab Technologies Lab, HSP, HRI<sup>2</sup>, NetS3, ADVR) UniGe (DIBRIS Bioengineering Lab and robotics labs, DINOGMI, DIMES), CNR (IEIIT, ICMATE), FISM (Rehabilitation Lab and Rehab Facilities), FDG, Gaslini (Fetal and Perinatal Medicine, Neurosurgery, Pediatric surgery Unit), HSM, Movendo Technology, Philips.

#### 3.4.1.2.4 WP4 – FUTURE OF IMAGE-BASED DIAGNOSTICS (CNR, GIUSEPPE PATANÉ)

**Task 4.1 – Smart materials and devices for imaging.** Smart materials, electronic hardware and platforms, devices, tools and techniques for advanced US, MEG/MRI imaging and diagnostic and interventional imaging will be exploited and developed. Deliverable: Prototypes of innovative materials, hw/sw solutions, and integration in pre-commercial devices.

**Task 4.2 – Innovative imaging.** Innovative imaging devices and AI-based tools and platforms for image processing, visualisation and analysis, taking into account the fragmented data landscape and interoperability, as well as data quality and privacy. Deliverable: Functional prototypes and validated AI-based tools and platforms.

**Task 4.3 – Data driven and knowledge-driven solutions for clinical workflow.** Data driven and knowledge-driven tools and platforms to optimize examination workflows, prioritise scans and reports, analyse and interpret structured and/or unstructured image data for prevention, early diagnosis, treatment, and follow-up of diseases and new disease markers. Deliverable: Suite of clinically validated AI-based and knowledge-driven tools for multiple uses.

**Task 4.4 – Transition of validated prototypes into commercial products.** New materials, AI tools and platforms for diagnostic and interventional imaging with a significant record of validation tests based also on regulatory compliance will be developed further to facilitate their evolution into commercial products. Deliverable: Novel commercial solutions.

Participating institutions and key assets/facilities: IIT (PAVIS, HSP, AMI), CNR (IMATI, ICMATE, SCITEC, SPIN), UniGe (DIBRIS, DITEN, DISSAL, DINOGMI, LiSComp Lab, MaLGa Lab, MIDA Group, CNR-UniGe Joint Lab on Movement Disorders), FISM (Neurorehab Facilities), Esaote, Gaslini (Fetal and Perinatal Medicine, Radiology/Neuroradiology), HSM.

#### 3.4.1.2.5 WP5 – MANAGEMENT (IIT, LORENZO DE MICHIELI)

WP5 will have the following main tasks and objectives:

- Ensure the immediate set up of the Work Plans by leveraging partners' existing infrastructures
- Monitor performance and support the WPs delivery, in compliance with the Spoke 2 timeline, and
- Ensure effective and timely communication and resolution of any issue that may arise in Spoke 2
- Coordinate with the Hub and Spoke 5 for training activities, technology transfer initiatives, dissemination
- Manage open calls for Cascade Funding to recruit researchers, and to involve further technological companies in the activities of Spoke 2, especially SMEs, and high-tech start-ups
- Create an Advisory Committee, which will include stakeholders from both scientific, industrial and administrative sectors to provide strategic guidelines to the Spoke 2 and address the open calls

(in mln)	Cost	MUR Funding	Co-funding
IIT (spoke)	<b>4,020</b>	4,020	0,000
CNR	<b>3,829</b>	3,829	0,000
UNIGE	<b>5,360</b>	5,360	0,000
ENGINEERING	<b>0,706</b>	0,412	0,295
SAN MARTINO	<b>0,412</b>	0,412	0,000
OSPEDALE GALLIERA	<b>0,412</b>	0,412	0,000
OSPEDALE GASLINI	<b>0,412</b>	0,412	0,000
DON GNOCCHI	<b>0,412</b>	0,412	0,000
FISM	<b>0,412</b>	0,412	0,000
PHILIPS	<b>1,480</b>	0,823	0,657
ESAOTE	<b>2,913</b>	1,646	1,267
MOVENDO	<b>0,768</b>	0,411	0,357
<b>Total cost of spoke and affiliate spokes</b>	<b>21,135</b>	18,559	2,576
Cascade Funding for Recruiting	<b>2,680</b>	2,680	0,000
Cascade Funding for POC (Proof of Concepts)	<b>1,800</b>	1,800	0,000
Cascade Funding for Support Ecosystem (CFSE-R)	<b>1,000</b>	1,000	0,000
<b>Total Budget on Spoke 2 (in mln of euros)</b>	<b>26,615</b>	24,039	2,576

### 3.4.1.3 Spoke 3 – Sustainable Environmental Caring and Protection Technologies (CNR, Marco Faimali)

#### 3.4.1.3.1 WPI – ECOROBOTICS&AI INNOVATIVE SYSTEMS (IIT, BARBARA MAZZOLAI)

##### Task 1.1 Innovative materials and sensors

- Renewable biomaterials for environmental caring; Natural Nanoparticles applied via surface spraying/injection/pelleting in marine habitats using robotic vehicles and mobile soft manipulators; superamphiphobic coatings with antifouling and anticorrosion properties for marine sensors and robot soft grippers; micro-nanoscale-textured photonic materials for radiation sensing; bolometers and magnetic field sensors.
- Miniaturised eco-friendly, plant-like sensory systems to detect physical and/or chemical parameters and release substances in plants; intelligent SWE (Sensor Web Enablement) modules for the acquisition of biological, physical and chemical variables of the water column and the seabed; polymer and hybrid polymer-inorganic photonic structures to detect chemical pollutants in water and air; biosensor to measure biofilm growth alteration as a warning for aquatic pollution; fluorescent sensor for the detection of organic compounds in natural and drinkable water.
- High capacity tensiometers that can measure pore water tensions in soils up to 7 MPa (i.e. well beyond the water cavitation threshold of 0.1 MPa, which is the limit of current commercial sensors) to monitor both unstable slopes for the assessment of landslide risks and agricultural land for the optimisation of irrigation.
- Biological Early Warning System through AI/ML tools for algal counting using low-cost optical system; systems to record organisms' motion and evaluate its alteration; opto-mechanical components to detect the alteration of the larval swimming “in a cage” of cryptobiotic planktonic organisms; tools to measure the alteration of the frequency of cirrus movements and the opening of the scuta of adult crustaceans as an index of pollution; “bivalve molluscs” models to monitor the presence and evolution of toxic algal blooms.

### Task 1.2 AI-driven environmental modelling

- Monitoring methodologies based on real-time adaptive sampling of environmental variables; data uncertainty representation, management and visualisation for decision support; reduction of the observation gap, complementing remote sensing with *in-situ* observations; ML methods to validate and assimilate data provided by citizens in forecast chains.
- Use of linear models that enforce sparsity to find the most informative environmental conditions about different problems, including spore dispersal, pollution transport and calibration of meteocean forecast.
- ML for image analysis in hydrogeological risk assessment, coastal erosion, sea surface pollution

### Task 1.3 Robotic Intelligent Systems

- Self-deployable and biodegradable soft miniaturised robots bio-inspired and dispersion abilities of plant seeds for environmental monitoring.
- Grasping&manipulation in air/water with bioinspired soft-robots via adhesion, suction, tactile intelligence.
- Legged robots and new locomotion algorithms for cleaning, monitoring, and sensor deployment; autonomous robots and sensors for wildfire prevention & fighting.
- Innovative, low-cost (open hardware/software) robots and AI-devices to operate underwater/surface/air.
- Cooperative navigation, guidance and control for teams of surface marine and underwater robots for monitoring, protection and enhancement of the marine environment.
- Fully autonomous teams of sensorized aerial and ground robots (tracked or wheeled) and "wearable" smart devices, patrolling the environment to adaptively extend the perceptual range of fixed sensors.
- Waterborne unmanned vehicles to operate in shallow water using air cushion technologies and AI.
- Integration of the above technologies towards an improved robotic ecosystem.

**Participants:** UniGe; CNR; IIT; Info Solution; ETT; CIMA; INGV.

#### 3.4.1.3.2 WP2 - SMART TECHNOLOGIES FOR ENVIRONMENTAL MONITORING AND TERRITORY MANAGEMENT (UNI GE, ANDREA MAZZINO)

##### Task 2.1 Forecasting models based on big data analysis approaches, AI and High-Performance Computing

- Metocean high-resolution models, calibrated via real-time observations, for extreme events.
- High-resolution numerical simulations of coastal dynamics based on hydrodynamical and Lagrangian models.
- Modelling tides effect, floods and sediment supply on rivers
- Groundwater flows for hydrogeological risk assessment and resources management.
- Photochemical transport models for predicting contaminants and pathogens dynamic

##### Task 2.2 Smart technologies for vulnerability analysis, risk assessment and territory safety

- Stormwater control measures for green infrastructures and data acquisition systems.
- Ocean surface currents and waves assessment through the Ligurian Radar Network.
- Risk assessment and management of landslides, based on GNSS, Lidar systems, geomorphological and precipitation data analysis.
- Early-warning system for short-term forecasts of extreme events for wind, precipitation, pollutants, landslide and other relevant climate variables; remote-sensing and smart rainfall systems for sea wave and rain monitoring.
- Identification, monitoring and characterization of pollutant sources and concentration.
- Geodetical monitoring systems based on low cost GNSS technology and data analysis

##### Task 2.3 Smart technologies for the protection and management of the environment

- Underwater multisensor platform for collecting and analysing visual and acoustic data; Hydrophones, triaxial high-sensitivity accelerometers, and AI-based tools for detecting underwater noise sources.
- Ground and aerial drones and AI-based systems applied to agri-food management.
- Marine environment protection and management through eco-robots and autonomous wearable devices.
- Spatial decision system and ecosystem service mapping for the protection and management of the environment.

**Participants:** UniGe; CNR; IIT; INGV; ENEA; algoWatt; Info Solution; ETT; CIMA.

#### 3.4.1.3.3 WP3 - SMART ENERGY STORAGE AND DISTRIBUTION (UNI GE, STEFANO MASUCCO)

### Task 3.1 Technologies for intelligent energy distribution

- Development of systems and tools for management, control and advanced intelligent protection of networks in presence of renewables and storage with fast communications
- Development of advanced functions for DMS (Distribution Management System) in electrical distribution networks. Application to real pilot sites.
- Design, development and validation of methods and tools for distributed resources coordination to optimise renewable energy use at local level (Energy Communities), and their interaction and service provision to distribution and transmission networks.
- Optimal management of electricity storage systems in buildings and districts for optimal decision making with deterministic and stochastic models. Stochastic models for the prediction of consumption and renewable sources in multi-energy-hubs.
- Data analytics techniques for the modelling and management of lithium storage systems and supercaps and experimental validation.
- Design and testing of solutions for quality of services and protection from cyber attacks in industrial-type networks with Machine Learning based approaches.
- Optimization of integrated management by dynamic modelling of networks and blockchain technology: models, methods and tools for automatic decision support for smart grids, EVs integration, power and energy networks.

### Task 3.2 Technologies for energy storage

- Matching, optimised production and electrical storage: AI applications to predict real energy transfer modes during charging and discharging of storage systems. Use of Robotized systems in tracking and maintenance of PV bifacial systems
- New models for simulating and predicting the performance of solar and geothermal heat pumps systems to be matched with thermal and electricity storage.
- Digital Twin "of electrochemical batteries to support the design of innovative solutions and optimization of integrated management. Applications to: Superconducting Magnetic Energy Storage (SMES); Superconducting Fault current limiter (SFCL); Superconducting energy generators for wind-mills.

### Task 3.3 Energy for autonomous systems

- Energy harvester devices based on the so-called "fluttering" effect to be used as autonomous power supply for small sensors.
- (nano)composite materials (ceramics/ceramics, polymer/ceramics, polymer/other additives), e.g. high-k capacitors, lead-free flexible films for energy harvesting and storage, actuators, sensors, nano-electronics micro-scale thermoelectric modules.
- Micro-scale thermoelectric modules.
- Development of scalable on-board multi-source green energy system for robotic platforms based on Photovoltaic, Fuel Cells and smart energy management unit

**Participants:** UniGe; IIT; algoWatt; Ansaldo Energia.

#### 3.4.1.3.4 WP4 - SMART DATA MANAGEMENT AND COMMUNICATION - PLATFORMS AND PROCESSING PIPELINES FOR THE DATA LIFECYCLE (ETT, ANTONIO NOVELLINO)

**Task 4.1 Effective and efficient processing.** The effectiveness and efficiency of front-end analysis mainly depend on the effectiveness and efficiency of the back-end ones. Data processing platforms have therefore to be designed on top of reference large-scale data processing (Edge-Fog-Cloud/IoT/Big Data/HPC) architectures, guaranteeing low throughput and latency in all the processing steps.

- Comparative analysis of existing solutions and design of a reference platform for the data at hand.
- Design of a data processing platform combining: (i) Edge-Fog-Cloud solutions, through low-power "system-on-chip" platforms to perform preliminary analyses on the same device that collects data and transfer only those data that are needed for subsequent steps; (ii) parallel and distributed data processing solutions based on large scale architectures (e.g., Kafka and Spark and related AI and machine learning libraries).
- Validation of the proposed platform through semi-automatic methods and monitoring approaches.

**Task 4.2 Efficient and effective data wrangling.** Efficiency and effectiveness can be further increased by the design of specific data wrangling pipelines for heterogeneous, possibly geo-referenced and time variant data, based on the solutions proposed in T4.1, tailored to their preparation for the next analytical steps.

- Design of data wrangling pipelines for large, heterogeneous, possibly geo-referenced, and time variant datasets.
- Exploitation of semantic information and external, open, and possibly textual, data for improving the accuracy of the data wrangling process.
- Validation of the proposed pipelines in the context of the platform proposed in T4.1.

**Task 4.3 Data visualization.** For large datasets, analytical techniques might not provide satisfactory results or require guidance for extracting significant information from them. In this context, data visualisation can be used beforehand for data analysis and exploration through interactive graphic tools, aimed at data interpretation, analytical request identification, and early-warning activities.

- Comparative analysis of existing data visualisation tools, policies, and techniques for their usage on the datasets at hand.
- Design of specific data visualisation approaches for early warning activities.
- Design of specific data visualisation approaches tailored to the following analytical processes.

**Participants:** UniGe; ENEA; ETT.

#### 3.4.1.3.5 WP5 - MANAGEMENT AND CONNECTION WITH THE OTHER SPOKES (CNR, MARCO FAIMALI)

**Task 5.1 Spoke management.** More in detail, the management activities carried out within this WP are:

- management of funding transferred from the hub and periodical reporting of costs and expenses;
- creation and animation of an Advisory Board, including representatives of the stakeholders and users of the research and development products created in the Spoke;
- monitoring of Spoke activities, projects and affiliates, and release of periodic progress reports;
- issuing of competitive cascading calls and setting up of commissions for the evaluation of applications;
- coordination with the Hub and with Spoke 4 for synergistic research activities and Spoke 5 for the implementation of advanced training activities and projects, technology transfer, dissemination, and public engagement.

**Task 5.2 Development of innovative technologically assisted Citizen Science systems.** This task will be devoted to creating, at proof-of-concept level, new robotic and AI systems dedicated to citizen science activities. Such tools will exploit multiple recreational / sports activities of citizens (diving, pleasure boating, local fishing, sporting activities, etc.) providing validated and immediately usable information for the monitoring of technologically assisted environmental data. This activity will be in synergy with Spoke 5, where the various POCs developed will be implemented in the general strategy of technology transfer, communication and public engagement.

**Participants:** UniGe; CNR; IIT; INGV; ENEA; algoWatt; Info Solution; ETT Solutions; Ansaldo Energia; CIMA.

<i>(in mln)</i>	<b>Cost</b>	<b>MUR Funding</b>	<b>Co-funding</b>
CNR (spoke)	<b>3,446</b>	3,446	0,000
UNIGE	<b>2,680</b>	2,680	0,000
IIT	<b>2,872</b>	2,872	0,000
ALGOWATT	<b>0,525</b>	0,342	0,184
CIMA	<b>0,823</b>	0,823	0,000
ETT	<b>0,642</b>	0,369	0,273
INFO SOLUTION	<b>0,534</b>	0,363	0,171
ANSALDO ENERGIA	<b>0,439</b>	0,211	0,228
ENEA	<b>0,969</b>	0,969	0,000
INGV	<b>1,070</b>	1,070	0,000
<b>Total cost of spoke and affiliate spokes</b>	<b>14,000</b>	13,144	0,855
Cascade Funding for Recruiting	<b>2,297</b>	2,297	0,000
Cascade Funding for POC (Proof of Concepts)	<b>1,800</b>	1,800	0,000
Cascade Funding for Support Ecosystem (CFSE-R)	<b>1,000</b>	1,000	0,000
<b>Total Budget on Spoke 3 (in mln of euros)</b>	<b>19,097</b>	18,241	0,855

### 3.4.1.4 Spoke 4 – Smart and Sustainable Ports (UniGe, Davide Giglio)

#### 3.4.1.4.1 WPI – UNCREWED AND AUTOMATED SYSTEMS FOR PORT AUTOMATION (IIT, FERDINANDO CANNELLA)

The specific tasks (projects) that will be developed within this research line are:

##### Task 1.1: Terrestrial robots

- Robotic environmental and port asset monitoring
- 5G and beyond 5G infrastructure for supporting very low latency and high reliability remote interaction with robot and automatic vehicles, and for managing edge computing resources for AI application and services
- Hardware and software for wheeled/legged robots for autonomous monitoring and human-in-the-loop inspections of infrastructures
- Development of Mixed Reality/Augmented Reality systems for remote inspection and surveillance
- Testing of terrestrial robotic monitoring systems at IIT's EURObench Facility

##### Task 1.2: Marine and underwater vehicles

- Development of a monitoring system for ports based on Autonomous Surface Vehicles (ASV) equipped with autonomous driving supported by machine learning techniques
- Development of autonomous navigation algorithms for marine underwater and surface vehicles operated in the port area. Target vehicles are port service boats/barges, as well as surface and underwater robots
- Prototype testing at DITEN-CompassLab (scale models) and DITEN-ShiLL Lab (Virtual simulation and Digital Twinning)

- Development of Robotics and Autonomous Systems for ship hull inspection (structural, antifouling and biofouling)

#### **Task 1.3: Aerial systems**

- Development of an aerial monitoring system of port docks and container stocking areas, based on fleets of autonomous micro-drones (UAV) and on AI-based coordination and patrolling algorithms for emergency risk alerting and prediction of environmental risks
- Development of an autonomous UAV (drone) powered by a hybrid (electric and fuel cells) high efficiency fast&safe power recharging system

#### **Task 1.4: Physical and virtual gate automation**

- Automatization of physical and virtual gates for vehicle and people check-in, and robotization of industrial equipment
- Integration of data-based and model-based methods for the optimal management of heavy vehicles movements at road gates of container terminals

#### **Task 1.5: HPC e Data Centric Computing for smart ports**

- Development of smart maintenance algorithm based on AI asset management
- Efficient management of data from heterogeneous sources via IoT platforms and HPC/Big Data infrastructures (e.g., dashboards for device management, CPU/GPU processing, agent-based monitoring)
- Retrieval of semantic information from large amounts of heterogeneous and geo-referenced data (e.g. Interoperability/ontologies) and discovery of non-obvious insights (e.g. embeddings for structured data)

**Participants:** IIT (Leader), UniGe, CNR, Aitek, algoWatt, Circle, EII, Fincantieri, Leonardo

#### **3.4.1.4.2 WP2 – MACHINE LEARNING AND REAL-TIME DATA FOR PORT SAFETY, SECURITY, AND SUSTAINABILITY (UNIGE, ANTONIO SGORBISSA)**

The specific tasks (projects) that will be developed within this research line are:

#### **Task 2.1: Inbound and outbound traffic flow monitoring and forecast**

- Massive IoT architectures to provide real-time localization tracking/forecasting data of inbound/outbound flows of vehicles and persons, and to monitor other parameters of interest, using 5G video-surveillance camera networks, and Wi-Fi technology
- ML and big data analytics for vehicle flows analysis, situation awareness and forecast
- Creation of a Living Lab targeted to the port environment with IoT-enabled interactive solutions, and user-friendly platforms for IoT innovations

#### **Task 2.2: Nowcast and forecast of marine conditions**

- ML for nowcast and forecast of Metocean conditions (wind, waves, currents) blending observations and numerical models and for advanced near real-time quality control of oceanographic data
- Tools for estimating particles trajectories dragged by the sea current in support of services for Search&Rescue operations and pollutant spills tracking
- Development of a real-time monitoring and transmission system for ports as early warning system for SLR based on a wireless underwater networking (IoUT)

#### **Task 2.3: Sustainability assessment and masterplan of port areas**

- AI-tools to evaluate energy consumption and emissions in port areas released by or related to ships, heavy duty vehicles, service vehicles, etc., referring to different time periods
- AI technologies for safety and environmental sustainability by monitoring acoustic signals from the port hinterland population and port workers (fusion of linguistic and physical data from acoustic sensors)
- AI-Tools for studying clean energy solutions for port infrastructure, vehicles, vessels: local renewables potential assessment, interaction with local energy grids and urban masterplans
- Tools and devices for continuous monitoring and data transmission of harbour marine environment quality

#### **Task 2.4: Risk assessment and resiliency of port areas**

- AI-powered dynamic risk-analysis tools for activities and logistics in port areas, related to storage and handling of hazardous goods, chemicals, and new fuels
- Development of ADAS systems based on AI to assist drivers in the optimal risk-based routing of tank-trucks in urban areas in proximity of port areas, and AI-based online training tools for professional training on dangerous goods
- Assessment human movements of port operators to monitor, evaluate and improve the work activities safety
- IoT networks of smart sensors, including GNSS-based devices, for continuous monitoring and assessment of structural safety of critical port infrastructures and of internal/external critical areas inducing potential hazards for port infrastructures and activities
- Resilience assessment based on a set of resilience indicators

#### **Task 2.5: Port protection and cybersecurity**

- Development of underwater detection systems for enforcing the peripheral security of port areas via 2-dimensional grid of intelligent nodes using magnetometers and light weight ML models
- Automation in cargo security and inspection: development of innovative methods to detect trafficking of Special Nuclear Materials (SNM) via neutron detection at transit points
- Threat intelligence for the anticipation of cyber and physical attacks, ML/AI-based detection of cyber-attacks to port infrastructure, and integrated cyber and physical situational awareness

#### **Task 2.6: Predictive maintenance of port resources and infrastructures**

- AI&Robotics in the manufacturing, inspection, maintenance and end-of-life activities of shipbuilding
- AI techniques to improve use, maintenance and optimization of railway transportation in ports
- Robots and wearable devices to monitor port areas and goods for the safety of people, critical infrastructures, and the environment (spills of hazardous materials, damage after strong wind, etc.)
- ML methods to train robots to replicate inspection strategies through Imitation Learning

**Participants:** UniGe (Leader), CNR, IIT, Aitek, algoWatt, Circle, ENEA, EII, Fincantieri, INFN, Leonardo

#### **3.4.1.4.3 WP3 – PORT OPTIMIZATION IN AN INTEGRATED FRAMEWORK OF TRANSPORT INFRASTRUCTURES (UNIGE, SIMONA SACONE)**

The specific tasks (projects) that will be developed within this research line are:

##### **Task 3.1: Digital twins and virtual models for ports / Advanced TOSs**

- Design and implementation of AI based optimization approaches for: yard storage management, ship and train loading operations, berth allocation
- Update digital twin virtual model in real-time by using sensors feedback and monitoring network output, visualise information on port physical locations with AR
- Synchronization of trains and trucks access and impact on both the yard occupancy and inside /outside congestion
- Integration of data-based and model-based approaches for monitoring maritime container terminals operations and online optimal re-planning of activities

##### **Task 3.2: Smart solutions and innovative processes for port management**

- Blockchain Technology in Port Community Systems
- Data sharing and collaborative analytics for Port operation support and performance monitoring and improvement
- Optimized management of the flows of people and goods at the interface between the port and the city
- Enabling conditions for a smooth implementation of smart solutions to port management
- Smart solutions for training and working activities assessment of port operators

##### **Task 3.3: Energy and resource efficiency of the port**

- Development of models, tools and IoT solutions for the energy management of the port system and demand response (buildings, electric vehicles, ships)
- Tool for the assessment of the most proper interaction of port energy/fuels assets and demands with local energy grids

- Development of models and tools for resource mapping in the port area aimed at promoting Industrial Symbiosis connections for a sustainable and efficient use of water, materials and energy

#### **Task 3.4: Regional and multiregional transport network optimization**

- AI methods and IoT schemes for cooperative logistics: monitoring, forecasting and planning of container flows to/from ports
- Intermodal network design and optimization of the import/export flows
- Optimal design of Port Buffer Areas Services for Road Transport Network
- AI tools for monitoring and managing dangerous goods movements on multimodal networks with risk evaluation and mitigation

#### **Task 3.5: Disruption management**

- Digital technologies to support the Business Transformation in Logistics: Moving applications to the Cloud and to the Edge
- Simulation/optimization approaches for the disruption management, DSS for mitigating transport and environmental disruptions
- Assessment of critical infrastructures for optimizing port operations thanks to metaheuristics including AI
- High-resolution numerical simulations of oceanic dynamics and AI for assessing the impact of adverse events on ports and areas nearby

**Participants:** UniGe (Leader), CNR, IIT, Aitek, algoWatt, Circle, ENEA, EII, Fincantieri.

#### **3.4.1.4.4 WP4 – AI-POWERED SERVICES FOR MEDIUM AND SMALL PORTS (CNR, FRANCESCA GARAVENTA)**

The specific tasks (projects) that will be developed within this research line are:

#### **Task 4.1: Automated human-centred services for tourism and recreational services**

- Development of AI & Robotics solutions for Ambient Assisted Living, such as Social Robots and Smart Environments, to support older and frailer passengers in maritime stations and on board
- Development of AI and Computer Vision technologies to localize and track people based on ambient sensing, including acoustic/ ultrasound, video & radio processing are needed
- Safety of Yacht Traffic. Tracking yacht transfer to transform Italian seas in safe and monitored touristic areas
- AI applications for managing, monitoring, and profiling people's needs so to promote inclusiveness and accessibility of differentiated port related services
- Development of scalable technologies adaptable to the size and main peculiarities of different involved port stakeholders

#### **Task 4.2: Harbour pollution and natural resources monitoring**

- Development of tools for continuous monitoring and data transmission of harbour environmental quality including emerging contaminants such as microplastics
- Development of Robotics and Autonomous Systems and process for the management of effective hull in-water cleaning and related chemical and biological pollution
- AI-Monitoring of marine mega-fauna (e.g., fish, benthonic organisms) in the port environment using autonomous and intelligent devices for image acquisition and processing
- Development of models and tools for resource mapping in the port area aimed at promoting solutions for the sustainable use of resources and for protection and regeneration of the natural capital

#### **Task 4.3: Scalability and replicability of port smart solutions**

- Design and development of technologies to create an "Intelligent Port" using both real-time and predictive monitoring systems
- Design of robotic and AI solutions for quayside logistics or rear port activities
- Development of simulation systems to ensure marine safety & security both in port and during navigation
- Development of an assessment and an AI based decision support systems for promoting scalable technologies adaptable to the size and main peculiarities of different involved port stakeholders
- Development of a Mobile Platform for the promotion of new port technologies, including scalability and replicability indexes and consistency with environmental and social long term port goals

- Development of a monitoring system for medium and small ports composed of an autonomous vehicle with driving capabilities enhanced by computer vision and machine learning techniques

**Participants:** CNR (Leader), UniGe, IIT, ENEA, EII, Circle.

**Existing research frameworks and infrastructures.** The following existing research frameworks and infrastructures can boost the immediate start and the realisation of the WP tasks. EU-MARINE ROBOTS, CIELI/DIEC Logistics and Maritime Observatory; EMAROLab; Laboratorio; Blue-Lab NET; MeteOcean; CIPI Lab for Yacht Safety, XoLab, RAIN, VICARIO, EURObench Facility, Industrial Robotic Facility, Franklin HPC IIT infrastructure. Hadoop/Spark/SparkML cluster for big data analytics (LSC lab@Dibris), Testing Facility for Robotics and Digital Technologies in the Marine Structures Testing Lab, SIOT, DruidLab, SeaLAB, RAIN, APRIL, INAIL Biomedical Robotic Lab, INAIL ROBOT TELEOPERATIVO, JOiINT LAB, PerGenova: inspection and maintenance of civil infrastructures (based on Genoa San Giorgio Bridge), UniWeLab joint lab between UniGe and WeBuild S.p.A. CEF FENIX; ELLIS, XoLab, AMI Lab, ShIL Lab, Transport Systems Engineering lab (Savona Campus), Research infrastructures and Energy Management tools for the Smart Polygeneration Microgrid and the Smart Energy Building (Savona Campus). ADVR (XoSoft, VICARIO Labs), DLS, HRI2, IF (URI, RAIN Labs), MW, PAVIS, RBCS, SRHCR.

**Synergy with other initiatives.** The tasks (projects) proposed in WP1-4 can be carried out in synergy with the following past and ongoing initiatives. EU Horizon: MONUSEN; EU H2020: ROBINS, DexROV, ROBUST, WiMUST, ENDURUNS, BLUEROSSES, RePAIR, SofManBot, ANDY, SOPHIA:, MINKE, CLAIM, ENGIMMONIA, IN2RAIL, IN2DREAMS, OPTIMA, DAYDREAMS, Fractal; MAELSTROM, SOPHIA, AUTOrecon, Pioneers. POR-FESR Liguria 2014-20: MARS, SINBAD, Efficacity, Aware, TIAMO, PICK-UP, ISIDE, GEREMIA, SPLASH!, SINAPSI, SPLASH&CO; INNOVAMARE; PON 2020 ARES; Dioniso, Marea, Prisma; POR-FSE 2014-20 BIOSEM, SIAP; Interreg ITA-FRA 14 – 20: SINAPSI, TRIPLO, SICOMAR, IMPACT, TOSCA, MATRAC-ACP, AWARE, ISIDE, PLASTIC, EasyLog; PNRM funds: MODA, PERSICO; DAMPS: DISTRIBUTED AUTONOMOUS MOBILE PASSIVE SONAR SYSTEM. EU JPI-Ocean: Response Others: Mise Genova 5G project; MiSe Lighthouse project, PerGenova (San Giorgio Bridge Inspection and Maintenance Robotic System). DG-ECHO Be-Ready; ERC Thunderr; Living grid-Technological Cluster on Energy, MIUR, 2017-2020, Energia 2020-Campus di Savona (2014-ongoing), COPERNICUS MARINE: PROVISION OF OCEAN OBSERVATION PRODUCTS - INS-TAC; Capitalization of ERDF Operational Programme 2014 – 2020 of Liguria Region; Echord++ HyQ-REAL.

#### 3.4.1.4.5 WP5 – SPOKE MANAGEMENT (UNI GE, DAVIDE GIGLIO)

Under this work-package, also the administrative tasks (mainly relative to the reporting of costs and expenses) will be carried out. More in detail, the tasks carried out within “Spoke management” work-package are:

- monitoring of activities and projects of spoke and affiliates, and release of periodic reports on their progress
- creation and animation of an advisory board
- issuing of competitive cascading calls and setting up of commissions for the evaluation of applications
- management of funding transferred from the hub and periodical reporting of costs and expenses
- coordination with the hub and with spoke #5 for the implementation of advanced training activities and projects, technology transfer, dissemination, and public engagement

Regarding the spoke Advisory Board, it will be initially formed by authorities, associations, consortia, etc. representing the port world, such as, for example: AdSP Mar Ligure Occidentale, AdSP Mar Ligure Orientale, Assiterminal, Confitarma, Spediporto. The technological districts of Liguria, SIIT and DLTM, and the research and innovation centres Polo TRANSIT and Polo SOSIA, will also participate. It will meet every 3 months, also to address the competitive cascade calls that will be issued for the implementation of activities and the provision of services by external parties. The cascade calls are planned to be issued every 3 months, presumably starting from the second month of life of the ecosystem. Apart from the calls to recruit researchers and technologists, calls will be mainly issued for: involving further technological companies in the activities and projects of spoke #4, especially SMEs, spin-offs, and start-ups that can provide innovative solutions; involving the port world, namely terminal operators, shipowners, freight forwarders, and so on, to allow the validation and demonstration on field of solutions, and to test prototypes in operational environment.

**Participants:** UniGe (Leader), CNR, IIT

<i>(in mln)</i>	<b>Cost</b>	<b>MUR Funding</b>	<b>Co-funding</b>
UNIGE (spoke)	<b>3,809</b>	3,809	0,000
CNR	<b>2,106</b>	2,106	0,000
IIT	<b>1,914</b>	1,914	0,000
ALGOWATT	<b>0,474</b>	0,305	0,169
ENEA	<b>0,518</b>	0,518	0,000
INFN	<b>0,428</b>	0,428	0,000
AITEK	<b>1,024</b>	0,700	0,325
CIRCLE	<b>1,288</b>	0,782	0,506
ENGINEERING	<b>0,925</b>	0,525	0,400
LEONARDO	<b>0,247</b>	0,123	0,123
FINCANTIERI	<b>2,245</b>	1,235	1,010
<b>Total cost of spoke and affiliate spokes</b>	<b>14,978</b>	12,445	2,533
Cascade Funding for Recruiting	<b>1,551</b>	1,551	0,000
Cascade Funding for POC (Proof of Concepts)	<b>1,800</b>	1,800	0,000
Cascade Funding for Support Ecosystem (CFSE-R)	<b>1,000</b>	1,000	0,000
<b>Total Budget on Spoke 4 (in mln of euros)</b>	<b>19,329</b>	16,796	2,533
Hub Management	<b>1,200</b>		

### 3.4.1.5 Spoke 5 – An engine for knowledge and technology transfer (IIT, Andrea Pagnin)

#### 3.4.1.5.1 WPI – ACCELERATION SYSTEM (IIT, LORENZO ROSSI)

**Task 1.1 Technological acceleration (IIT, CNR, UniGe):** the technological acceleration phase is partly developed within the thematic spokes, because it is strongly linked to the testing needs, but it requires a support action by specialized personnel that is managed within Spoke 5 that may support the creation of living labs with selected companies and public operator (e.g. municipalities) to test the "Proof-of-Concepts" deriving from the research phase. This phase makes it possible to create a sort of “gearbox” between the needs of the market and the technological solutions developed in each spoke, encouraging early bilateral exchange of know-how between companies and re-searchers.

**Task 1.2 Strategic acceleration (IIT, CNR, UniGe):** technological solutions, developed in the ecosystem and adopted by one or more companies could effectively change the product-service or business model of the company adopting them, and thus its way facing its competitors. This only happens if the awareness of the use of the product-service grows together with a strategic vision that frames the new technology adopted in a possible change of positioning, including organizational change. To face the organizational change and the consequent strategic change the company would need a specific strategic support. This kind of support will be provided within the ecosystem by affiliated entities (that may have an interest in the development of the supply chain linked to them), by specific companies that are identified by cascading calls or by joint teams of partners in the ecosystem.

**Task 1.3 Financial acceleration (IIT, CNR, UniGe):** the ecosystem considers providing both start-ups and mid-sized companies with financial solutions to promote their development by adopting technology that change their market positioning. The technological solutions derived from the thematic spoke are "brought closer" to the market and the

possible use to solve real needs. This makes more attractive the investment phase that can be evaluated by a specific investment community (Funds, venture capitalist, etc. linked to research centres involved in this project) that encompasses over 50 private and public investment funds able to accompany these innovations to-wards the market. In this way the initiative "Roboit" (roboit.it - National Center for Technology Transfer of Robotics), founded by IIT and "Cassa Depositi e Prestiti" (Italian National Promotional Institute) on the area of the Ecosystem represents only one of the possibilities that the companies approaching the ecosystem will be able to seize.

**Task 1.4 System of cascading calls (IIT, CNR):** to encourage the opening up of the ecosystem and its growth, the above steps will use an advanced system of cascading calls that will be supported by a systematic use of presentations and roadshows at national and international level using the channels provided by the Italian industrial system (Confindustria or connecting to ecosystems such [www.eitmanufacturing.eu](http://www.eitmanufacturing.eu). some examples of the cascade system of calls for tender envisaged: calls for industrialization; calls for start-ups; calls for growth; calls for discovery; calls for investors; calls for private incubators

#### 3.4.1.5.2 WP2 - INCUBATION SYSTEM (IIT, ELISABETTA MIGONE)

**Task 2.1 Development physical spaces dedicated to disruptive start-ups (IIT, CNR, UniGe):** the objective of this Task is to coordinate and share the regional incubators activities (incubators owned by Regione Liguria and IIT incubator) in order to offer to the start-ups created within the ecosystem a physical space fully equipped to work in, with all the related services useful to companies. The space will have to satisfy the needs of the different types of start-ups and offer an all-inclusive service that allows the start-ups to focus on business and product development without the need to deal with office issues.

**Task 2.2 Build a start-up ecosystem (IIT, CNR, UniGe):** to support promising start-ups and/or companies looking to scale, a start-up ecosystem needs to provide access to management talent, which requires both the availability of experienced executives and a network within the ecosystem that can match them with growing companies. The creation of a community that brings together all the stakeholders of the ecosystem is a natural booster to the growth of individual members.

#### 3.4.1.5.3 WP3 – ETHICAL AI & ROBOTICS (UNI GE, ANNALISA BARLA)

**Task 3.1 Legal compliance for AI (UniGe, IIT, CNR):** to study and summarize in a usable format the laws and legal requirements that define a trustworthy AI application and ensure its legal compliance. In particular we will focus on the transparency of the software engineering process during implementation should allow technical inspection of which norms have been implemented, explicitly and implicitly, for which contexts, and how possible conflicts are resolved.

**Task 3.2 Human centric AI (UniGe, IIT, CNR):** a design process for AI application is devised, starting from two key competences: human-centred design and machine learning. On one side, the expertise on user research becomes key in defining what is the goal of AI applications and what are the actual needs of final users. On the other end, machine learning experts make sure that proper algorithms and experimental settings are in place to implement such needs.

**Task 3.3 Designing the Robotics and Artificial Intelligence indexing (UniGe, IIT, CNR):** the research centres involved, the University of Genoa and affiliated companies will provide a joint team to study an index that quantifies AI application trustworthiness. The index will be used on the AI applications of the thematic Spokes to facilitate the technology transfer phase.

#### 3.4.1.5.4 WP4 – ECOSYSTEM IDENTITY (IIT, ANDREA PAGNIN)

**Task 4.1 Business Development and Internationalization (IIT, CNR):** the ecosystem should have a continuous and structured dialogue with companies to intersect and understand their needs and become a solver through technological solutions derived from the technologies developed within the "thematic spokes". These technologies should be known, promoted to the widest possible audience through a promotional and commercial drive that cannot be limited to the area where the ecosystem is located.

**Task 4.2 Market Analysis and Strategy (UniGe, IIT):** to implement an optimal technology transfer strategy, it is necessary to have a clear understanding of both the potential impact of the innovative technologies on existing markets, and their role as a driver for new markets creation. This task is intended to carry out a systematic analysis on the most relevant technology/market/application combinations within the field of interest. The aim is twofold: from one hand, the survey on the evolutionary needs of potential adopters and the application trends of the technologies under development may provide valued services to firms engaged in the eco-system. From the other hand, the quality of information provided systematically may contribute to affirm the ecosystem as a point of reference for knowledge at national and international level.

**Task 4.3 Business Communication (IIT, UniGe, CNR):** one of the most crucial issues of the RAISE ecosystem is to develop a recognizable identity, both at national and international levels. To do so, a sharp and extensive communication strategy must be developed, considering the various stakeholders as specific targets. In this vein, to raise communication effectiveness, we have planned to consider separately the actions towards the institutions and the people, aiming respectively at obtaining recognition and support by the former, as well as awareness and involvement by the latter (see WP. 5.6), from actions oriented to firms as a primary target. More specifically, the task related to business communication is intended to affect firms' awareness and attitudes towards the ecosystem, laying down the building blocks of its brand identity.

**Task 4.4 Intellectual Property and Knowledge Protection and Transfer (IIT, CNR, UniGe):** the mission of this task is strategy, statement, accountability, evidenced approach, commitment and recognition of Intellectual Property and Knowledge transfer to create a measurable impact on the society. A strategic plan for the protection and transfer of the Intellectual Property Rights will be designed and implemented in compliance with the recommendations laid down by the Steering Committee of the HUB. The guidelines for the management of the Intellectual Property Rights co-owned by parties with different institutional goals and objectives must be clearly defined in a framework agreement negotiated between the associates.

**Task 4.5 Human Capital Management (IIT, CNR, UniGe):** the ability to attract talent both in research and in its support activities is one of the key elements to ensure the long-term sustainability of the ecosystem. Start-ups need managers and staff to complete their teams, and small and medium-sized companies need resources capable of managing organizational change. Not secondarily and in coherence with the vision of the Italian government we have to manage gender equality with strategies and good practices. For this reason, we plan to build a specific objective to manage these aspects and to promote the ecosystem as a place to work on the future of the Italian industry.

#### 3.4.1.5.5 WP5 – COMMUNICATION & PUBLIC ENGAGEMENT (CPE) (CNR, MARCO FAIMALI)

**Task 5.1 Communication and Public Engagement Plan (CPE Plan) (CNR, IIT, UniGe, ETT, AFS):** the CPE Plan approach includes four key elements to develop a dynamic and innovative ecosystem of skills to apply robotic and artificial intelligence technologies to the environment and health. Overall, the multi-approach strategy will be supported by an easy-to-use framework designed to help project teams to articulate the scope of the project. The planned activities mainly concern: design a Project Dissemination Board (PDB) composed of scientific representatives and a Communication Management Team (CMT) made up of communication experts of the subjects affiliated to the Spokes, creation of an External Cross-Media Production Team (ECMPT), developing engagement techniques and tools for the different research topics of each spoke in accordance with the different engagement processes and specific objectives resulting from the stakeholders and user analyses, create and implement an Engagement & Communication Strategies outlining the public engagement goals and objectives for each spoke and aligning the most appropriate tools to achieve the objectives of involving the different spokes.

**Task 5.2 New languages (CNR, IIT, UniGe, ETT, AFS):** rethinking science communication through the experimentation of new formats: it is the time to update and implement the active involvement of the public in science (Public Engagement in Science) through the experimentation of new formats, which highlight not only the acquisitions of science of robotics and artificial intelligence applied to health and the environment but also its methods, by promoting hand-on approaches (e.g., citizen science).

#### 3.4.1.5.6 WP 6 – HIGHER EDUCATION & TRAINING (UNI GE, NICOLETTA BURATTI)

**Task 6.1 Growing up basic AI and robotics skills (UniGe):** creating AI & robotics curiosity, culture and basic skills. Fostering innovation culture, in an anticipatory thinking view, on AI and robotics applications. Enhancing the number of STEM students. In order to meet the skills needs of companies (with particular reference to SMEs) in a framework that is constantly evolving in technological terms, training courses will be set up for non-technical undergraduates and in collaboration with secondary schools, also working on the training and updating of teachers.

**Task 6.2 Building Advanced AI & robotics skills (UniGe):** to highly develop AI & robotics professionals, specialized in 4 spokes business, by a postgraduate master degree program, to build the most requested professional profiles in the field such as Machine Learning Engineer, Robotic Scientist, Data Scientist, Digital Innovation and Sustainability Expert. The two years programs will be co-designed within the RAISE ecosystem and realized with almost the 50% industrial and professional teachers and field training projects within living and contamination labs. On the other side, a program of Industrial Doctorates will be offered, addressed both to RAISE ecosystem enterprises, both to any other would join the programs. The PhD students are expected to carry out a research stage inside companies, focused on thematic areas driving the regional economy, in the perspective of increasing the employment in the field of the major areas of research and innovation and related areas of intervention defined in the National Research Program 2021-2027.

**Task 6.3 AI and robotics potential for public and private companies and institutions (UniGe):** continuous professional development to understand AI, its potential for business and the opportunities for its implementation, to better understand how AI can be implemented within their organizations. This task is mainly addressed to SMEs, but training courses are open to all ecosystem enterprises. Through innovative procurement labs, and crossing the MIC1 PNRR designed actions for P.A., enabling and activating public administrations to deploy products and services that rely on AI in their activities so that AI applications can contribute to better public services by improving interaction between citizens and governments and enable smarter analytical capabilities.

**Task 6.4 Vocational training in management for innovation (UniGe):** designed for who already lead an enterprise or aim to in the future, the task is intended to strengthen their management skills, to enhance the understanding of how to commercialize an idea, from innovation to market, to acquire the mindset and the fundamental skills and insights to build, manage and grow an innovative start up. Providing entrepreneurial and management tools to innovative start-ups and SMEs, such as strategic vision, international perspective, business development, marketing, finance, organization, with a program of post-graduate and executive training in Deep-tech Entrepreneurship and Management, with the continuous support and mentorship of a manager/innovative entrepreneur.

#### 3.4.1.5.7 WP7 – GOVERNANCE AND MANAGEMENT (CNR, CRISTINA BATTAGLIA)

**Task 7.1 Advisory board (CNR, IIT, UniGe):** composed of representatives of the hub and members of industry and trade associations and the regional innovation system

**Task 7.2 Evaluation board (CNR, IIT, UniGe):** composed of independent experts appointed by the ecosystem founders and advisory board representatives

**Task 7.3 Investment Advisory Council (IIT, CNR, UniGe):** experts nominated by the founders from consulting firms, investment funds, and development support entities at national and international level.

**Task 7.4 Evaluation Program (CNR, IIT, UniGe):** design of the evaluation and impact analysis system that will support the decisions of the committees at spoke and hub level.

	(in mln)	Cost	MUR Funding	Co-funding
IIT (spoke)		2,949	2,949	0,000
CNR		3,255	3,255	0,000
UNIGE		3,297	3,297	0,000
ETT		0,707	0,345	0,363
ASSOCIAZIONE FESTIVAL DELLA SCIENZA		0,436	0,262	0,174
<b>Total Cost of founders and affiliate spokes</b>		<b>10,644</b>	10,107	0,537
Cascade Funds for Recruiting		1,836	1,836	0,000
Cascade Funding for POC (Proof of Concepts)		1,800	1,800	0,000
Cascade Funding for Support Ecosystem (CFSE, CFSE-I, CFSE-R)		19,500	19,500	0,000
<b>Total Budget on Spoke 5 (in mln of euros)</b>		<b>33,780</b>	33,243	0,537
	(in mln)	Cost	MUR Funding	Co-funding
IIT (spoke)		2,949	2,949	0,000

<b>CNR</b>	<b>3,255</b>	3,255	0,000
<b>UNIGE</b>	<b>3,297</b>	3,297	0,000
<b>ETT</b>	<b>0,707</b>	0,345	0,363
<b>ASSOCIAZIONE FESTIVAL DELLA SCIENZA</b>	<b>0,436</b>	0,262	0,174
<b>Total Cost of founders and affiliate spokes</b>	<b>10,644</b>	10,107	0,537
<b>Cascade Funds for Recruiting</b>	<b>1,836</b>	1,836	0,000
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<b>Total Budget on Spoke 5 (in mln of euros)</b>	<b>33,780</b>	33,243	0,537

### ***3.5 Composition of the work group and consistency between the activities to be carried out and the skills of the executing subjects***

The working group involved in RAISE was composed through a rigorous evaluation and selection process carried out by the Spokes' managers who, within their organisations and on the basis of the affiliates' proposals, identified the best competences to carry out the activities, taking into account the criteria set out in Section 3.1.2. Particular attention was given to the correct gender balance as well as to the involvement of young researchers and strongly multidisciplinary skills within each SPOKE.

**SPOKE 1** has gathered a multidisciplinary team able to address inclusiveness from the challenging perspective of the urban context: not only proposals for innovative technologies per se, but also methodologies to bring innovation into the urban planning process. The team was therefore selected to ensure:

- Expertise about the physical and physiological characterization of the type of impairments and age groups we are considering: HSM, Galliera and Gaslini
- Expertise in research of solutions to accompanying disabled along their lifetime: FDG and FISM
- Excellent scientific and technological know-how on robotic systems and devices as key drivers for the development of innovative supportive systems: IIT, CNR, UniGe and ETT.
- Expertise and vision about Smart City and how the concept can evolve thanks to the hybridization of the city services with AI and robotics: CNR, UniGe and EII.

These ten institutions will be supported by the most important partner of spoke 1 to be engaged as-early-as-possible in the project evolution: the many associations of the Third sector located in the territory, stakeholders of interests and spin-off of technologies. The spoke has already relevant connections, which are represented also by the involvement in RAISE of the Ligurian Innovation Pole of Life Science, hub of the many companies and entities relate to the wide area of Life Sciences and including well-being as one of its activity axes. The consortium Si4Life<sup>1</sup> is an example of a highly relevant local partner to be involved thanks to the Cascade Funding mechanism.

**SPOKE 2** counts on an extremely rich partnership in three areas that are essential for any innovation process in the health sector: **scientific and technological research, clinical practice, and biomedical industry**. Indeed, Affiliates of Spoke 2 include: three clinical research institutions specialized in neurology and oncology (**HSM**), paediatrics (**Gaslini**), and rehabilitation (**FDG**); one Hospital with strong vocation in geriatrics (**Galliera**), especially in the clinical

<sup>1</sup> <http://www.si4life.it/>

management of elderly and frail subjects with multiple term pathology; the Italian Multiple Sclerosis Society (**FISM**), which is the leading funding agency of research in Multiple Sclerosis field in Italy and the third funding agency worldwide. All these Affiliates have a strong expertise and an outstanding track record not only in conducting experimental clinical validation of new technologies, but also in co-developing new high-tech solutions together with **IIT**, **UniGe** and **CNR** (e.g., H2020 FET PROACT EnTimeMent, H2020 FET Open OXiNEMS, H2020 Industrial Leadership Project TAILOR). In addition, Affiliates include **high-tech companies** active in **global markets** that are of paramount interest for the success of Spoke 2, such as med-tech, digital technologies, and robotics. Involved companies are: two international leaders providing medical imaging solutions in Ultrasound, MRI, imaging technologies for the interventional sector (**Esaote**), and solutions that combine healthcare systems, smart devices, and AI (**Philips**); one leading company (**EII**) on the digitalization of processes in the healthcare sector; one innovative biomedical company (**Movendo Technology**) that designs robotic technologies and AI-based solutions to improve and simplify clinical processes and treatments in healthcare. All these companies have already established fruitful research and clinical collaboration with major institutions in Italy, such as Programma Operativo Nazionale Brain Virtual Interactivity Platform – BraVI.

Spoke 3 is led by **CNR** together with **IIT** and **UniGe** as affiliates; the three main scientific partners are complemented by environmental agencies/research centers (**CIMA**, **ENEA**, **INGV**) and industrial partners, who bring to the Consortium ICT and robotic solutions (**ETT**, **Info Solution**) and expertise in sustainable energy production and management (**AlgoWatt**, **Ansaldo Energia**), while benefiting from the technology transfer of the research outcomes. The Consortium brings to the project scientific and technological multidisciplinary competences, ranging from the design and control across multiple types of robotic platforms, sustainable materials and (bio)sensors, biological and chemical knowledge, AI-based data analysis and modeling, enabling technologies for smart energy distribution, data collection, environmental monitoring and prevention systems. The Consortium as a whole is also able to cover a broad range of robotic systems operating in marine (surface/deep water), aerial, and terrestrial (wheeled, legged, bioinspired) environments; sensors and bio-sensors for a variety of environmental variables and pollutants are also available, and new ones will be developed through the use of innovative materials. The affiliates possess a wide range of models and systems for the monitoring, forecasting and early warning systems of diverse phenomena (rainfall, stormwater, landslides, tide, pollution, and many more), and the integration foreseen within the Spoke is expected to produce new prototypes and bring those already developed to a higher TRL. INGV, CIMA and ENEA will provide the application perspective and context, with concrete problems and intervention priorities, and further connections with the territory and local administrations (e.g., Protezione Civile, Regione Liguria). ENEA with its Marine Environment Research Center and the Smart Bay are ideal locations for monitoring the marine environment, equipped for performing biochemical and physical analyses, and are already part of EMBRC and LTER networks. These areas will be available as test areas for the technologies developed within Spoke 3.

The research activities in **SPOKE 4** are led by spoke **UniGe** with two affiliated ones: **CNR** and **IIT**. They cover all the methodological and technological areas with a strong interdisciplinary and a continuous exchange with the industrial partners and stakeholders. The research fields of the several Departments, Institutes, and Units involved in the research and innovation program includes robotics and AI together with a wide range of enabling technologies and methods, as well as other disciplines related to port environment, thus making possible to face and overcome the challenges that will arise in the ecosystem. The three main spoke partners, namely UniGe, CNR and IIT, are joined in SPOKE 4 by a suitable mix of public organizations and large and medium private industries. **Leonardo** and **Fincantieri** have always worked with Liguria ports, and they have research, development and innovation departments on the issues considered in the spoke but also in the whole ecosystem. Also **Aitek** and **Circle** have been collaborating with Liguria ports for years, precisely as regards the introduction of new technologies aimed at making port activities smart: in spoke #4 they propose several solutions for port automation, data and video analysis with ML-base techniques, optimization of logistic processes. **Algowatt** and **EII** are companies providing technologies in various fields, and they will be involved in specific tasks such as those related to port activities monitoring, risk and resilience assessment, smart solutions for port management. The public organizations involved in spoke #4 are **INFN**, with its competencies in the field of nuclear materials, and **ENEA** that will contribute to many tasks relative to energy and resource efficiency of ports.

The **SPOKE 5** was conceived and designed as the main channel for transferring the value developed through applied research to the market and the area in which the ecosystem is located. The spoke 5 will be led by The Italian Institute of Technology (**IIT**), which has a specific focus on the technological domains (Robotics and AI) and a specific State mission about technology transfer issues: according to European Patent Office (EPO) IIT is the first Italian non-industrial organization by number of patent applications submitted to the EPO and among the top Italian organizations (Technology Transfer activity has led to 1100+ [patents or patent applications](#), [28 start-ups](#) already launched and 50+

start-up projects). Therefore, beyond IIT, sees collaboration with founders of RAISE and will be use of the experience in Knowledge Transfer and Dissemination processes of the **CNR** and **UniGe**, which have a high-quality research and training capacity on the topics of Robotics and Artificial Intelligence. In addition, the consortium on spoke 5 includes: **ETT** an high-tech company, active in global markets specialized in conceiving and developing digital solutions based on innovative technologies (Augmented Reality, Virtual Reality, mobile, IoT, AI, ML, data analysis, geo-located data, etc.) and the **Genoa Science Festival Association**, a no-profit organization for promotion and dissemination of science and technology to the large public that has set up an international research network and collaborations with many organization, museums and institutes in Liguria, Italy and in the world.

### ***3.6 Actions for the promotion of equal gender opportunities in all aspects of the research and innovation programme***

Aiming at the United Nations Sustainable Development Goals, in particular to n. 3 (Good Health and well-being), n. 4 (Quality education), n. 5 (Gender Equality), n. 7 (Affordable and clean energy), n. 8 (Decent work and economic growth), n. 9 (Industry, innovation and infrastructure), n. 10 (Reduced inequalities), n. 11 (Sustainable cities and communities), n. 13 (Climate action) and n. 17 (Partnerships for Goals), and inspired by the postulates stated by the Women's Forum for Economy and Society (WFES), RAISE envisages a world where women are equal actors and decision-makers across the spheres of politics, business and society. It envisages a gender perspective and aims at inclusive solutions to its social and economic challenges. The path towards the Zero Gender Gap in economy and society follows a mix design between the top-down measures integrated in their governance by main public and private stakeholders. In fact, the WFES claims to address, for 10 years in G20 countries, 3% of the global corporate tax to balance gender in scientific and technological education, equal to 150 billion dollars, in the general benefit. In parallel, bottom-up voluntary adoption of good practices towards gender equity are proposed.

**Governance of the RAISE Ecosystem.** The fields to address across a woman's life span are expanded access to: i) education ii) health care and iii) work opportunities. I) The RAISE Ecosystem will address gender balance and woman empowerment at several levels, meeting the five dimensions of the Gender Equality Index (GEI,): female leadership and talent pipeline, equal pay, inclusive culture, anti-sexual harassment policies and branding pro-women. RAISE voluntary adhesion to GEI principles will be implemented through the three years' time span of the project and is meant to become a tool for an inclusive supply chain. In its starting stage, RAISE Boards and the Spoke Advisory boards are built including according to the principle of gender equity. The aim is to achieve as far as possible the gender balance in its mature stage.

**Education.** RAISE believes that raising social awareness on increasing technological education will provide better opportunities towards advanced, inclusive, and sustainable jobs. However, this rationale is hindered by a gender bias in education, conveyed by cultural roots and social expectations. In 2017, the term “*dream gap*” was coined to describe the pervasive influence of the gender stereotype on girls' ability at the earliest years of education, invalidating the natural bent to games and activities surreptitiously meant for the so-called smarter kids, and diverting girls from STEM studies, education, and careers. The public engagement activities in education of RAISE are addressed to disseminate the curiosity towards novel technologies and the potential of their applications, encouraging in young generations the freedom to develop one's own inclinations, empowering talent development and scouting by the synergic collaborations of Education institution and companies (e.g., the techno-laboratories for children carried out by Leonardo). In this field of activities, girls' awareness and mentoring will be particularly attended to. The orientation activities will be mainly addressed to teenagers through seminars, and grants dedicated to fill the gender bias. In this pervasive action, the synergic engagement of middle schools, University and companies will be the most effective tool. Finally, women who select a University STEM course will be rewarded by incentives on university fees or by offering opportunities to students of stages, grants to foreign institutions and companies, mentoring, and to PhD students, free APC to publish scientific articles.

**Career opportunities.** The increase in female occupation will be achieved through the Mission 5: Inclusion and Cohesion, National New Skills Plan, promoted by the Ministry of Labour and Social Policies in collaboration with ANPAL and in agreement with the Regions, with the aim of reorganize the training of workers in transition and the unemployed, through the strengthening of the vocational training system and the definition of essential levels of quality for upskilling and reskilling activities. The Equal pay instance would be carried out by applying to the PNRR Mission 5: Inclusion and Cohesion, the Reformation 1.1. Female entrepreneurship opportunities, and the Component 1.2 Creation of women's businesses. To increase women's participation to the market, RAISE will deploy activities of technology incubator and of economic accelerator in Spoke 5 with an eye on women promotion. Further activities as

mentoring, technical-managerial coaching and work-life balance measures will be encouraged and made available. Finally, taking advantage from the contiguity of companies, public research entities, schools and University, specific actions of targeted communication/formation on business creativity, case studies on resilient/intuitive solutions carried out by women will be designed.

**Monitoring the impact.** RAISE acknowledges the Inclusive Sourcing Journey proposed by the Women4Business Daring Circle of the Women's Forum. This new digital tool will assess the maturity, reach and impact of an organization's supplier diversity and inclusive sourcing practices. The implementation of this tool will be care of Chief Procurement Officers, Senior Procurement Professionals, or Diversity & Inclusion Executives. Finally, the activities of the Ecosystem to reduce gender gap will be updated following international and local dynamics.

### ***3.7 Ways of involving scholars who have obtained their PhDs in the last 10 years and how to attract some of them from EU and non-EU countries***

One of the main objectives of RAISE is to have an impact in terms of attracting young researchers from EU and non-EU countries to the territory, and the HUB and all the SPOKES will contribute energetically to this objective. RAISE's initiatives will involve not only scientific institutions but also local authorities, businesses and trade associations, addressing attractiveness from all relevant axes: scientific quality, distinctiveness of the research offer, opening of professional perspectives, logistic support, cultural hospitality. The formal mechanism that RAISE plans to adopt is to structure specific **international grants** to be awarded to young researchers from outside Liguria, EU and non-EU countries. Ecosystem resources and an extra budget sponsored by ecosystem participants will contribute to these grants. The grants will finance the salary and a share for research and development activities **focused on strategic topics** for the development of the ecosystem, which will highlight the very multidisciplinary flavour of RAISE's topics and communicate their innovation potential. The number of young researchers involved in the ecosystem will be measured through specific impact indicators, characterizing the reach out RAISE. To guarantee the effectiveness of this action, the grant will be integrated with specific initiatives to support the hosting of young researchers. In particular, an adequate number of residences will be reserved for the ecosystem as part of the new university housing projects that the University of Genoa (together with the Liguria Region and the Genoa City Council) is implementing throughout the region (under Law 388 and the Sustainable Housing Plan for the Genoa City Council). The local authorities will also promote a service card dedicated to young researchers to facilitate mobility (resources for integrated sustainable mobility: electric buses, train, and cycle paths connecting with universities), access to cultural and sports and recreational facilities.

An initiative of great importance for the achievement of the goal is the participation of the University of Genoa in the European Ulysseus University (<https://ulyseus.eu/>). Ulysseus is a European university, one of 41 transnational alliances promoted by the European Commission to make them the universities of the future by promoting European identity and values and revolutionizing the quality and competitiveness of higher education in Europe. The Ulysseus specific goals are: contribute to the modernization of our educational institutions by developing a long-lasting Ulysseus territorial and digital Innovation Ecosystem, implement a series of student-centred, flexible, and work-based European Joint Programmes, interlinked with research and knowledge transfer activities, prepare highly skilled digital, multilingual, and entrepreneurial European citizens through a combination of innovative learning and teaching activities. Among the specific objectives of Ulysseus, which are fully consistent with and reinforce the objective of RAISE in terms of attracting young researchers, the following should be highlighted: Mobility of students, academic and non-academic staff, Green Deal mobility scheme for climate protection, High Schools mobility, International cooperation, Welcoming international visitors, Talent Magnet and International promotion. All these actions will be supported by a specific communication campaign to promote the identity and aims of the ecosystem in the main universities and research centres operating in RAISE's target sectors.

To involve scholars who have obtained their PhDs in the last 10 years, the RAISE ecosystem will adopt a recruitment approach and development strategy that will ensure a fair and transparent selection and judge the merits of the candidates according to their potential, previous qualifications and experience. The recruitment process will follow the guidelines set out in the EC's Charter for Researchers and Code of Conduct for the Recruitment of Researchers. Furthermore, the RAISE ecosystem will respect the European policy of non-discrimination and equality between women and men in the Treaty of the European Union (Articles 2 and 3). The positions will be open to all EU and non-EU nationals. It will be widely publicized to attract top-level candidates. The RAISE ecosystem will respect the European policy of non-discrimination and equality between women and men in the Treaty of the European Union (Articles 2 and 3). To recruit high-quality human resources, the candidate selection criteria for experienced researchers will include research excellence, management experience, international research experience, research publications and motivation.

Furthermore, the RAISE ecosystem will also offer a personalized Career Development Plan (agreed between the “scholars” and the RAISE supervisors), which will cover: (i) short and long-term development goals, (ii) training needs including complementary skills. The RAISE ecosystem will pay specific attention to the enhancement of career perspectives and employability of the recruited researchers to public and private sectors (involving industry and research institutes), also via training and mentoring programs. By embedding key aspects of expertise including task-oriented research skills, generic research skills, as well as transferable skills in the training activities, the RAISE researchers will experience a wide range of interdisciplinary and intersectoral training and research in AI and robotics. According to the RAISE financial rules, a Career Exploratory Allowance (fixed amount) will be planned for each researcher with a stay of at least one year. To guarantee the attractiveness of the scholarships offered by RAISE, complementary training packages will be offered to develop career appropriate skills. As main examples, we mention (i) communication, IPR, ethics, grant writing, commercial exploitation of results, research policy, entrepreneurship, language classes, etc; (ii) conference and workshop attendance.

### ***3.8 Level and methods of involvement of private entities, large companies and SMEs, of local public authorities (also in terms of co-financing) and of local scientific, technological, cultural and civil society institutions***

RAISE was prepared with early actions on the territory, aimed at consolidating the RAISE idea and promoting its potential for the local stakeholders. Several presentations and workshop were organized for the presentation of the RAISE concept to regional stakeholders and the workshop dedicated to the definition of the impact areas of the SPOKES (see Section A), and the HUB founders issued a call for expressions of interest in participating in the ecosystem's activities to prepare and guide the selection of the main actors of the ecosystem. The call has been distributed through the regional network of Innovation Hubs, Districts, Competence Centres, Digital Innovation HUBs and trade associations and reached a wide audience: more than 1,200 subjects (companies, local scientific institutions, cultural institutions, etc.), most of whom responded by indicating the level of involvement and the specific contribution they intended to make to the ecosystem. According to the expressions of interest received, a precise verification of the requirements of the call for proposals was carried out: scientific quality and previous experience in the fields of robotics and artificial intelligence with an impact on the application domains of RAISE. The selected subjects (affiliated to the SPOKES) were then involved in plenary and/or individual discussions to share the general objectives of RAISE, the implementation modalities and their operational involvement in one or more SPOKES. The result of this work (as extensively clarified in the description of the specific SPOKE workplans) has led to a full involvement on RAISE activities of all affiliated actors, as well as of the SPOKE founders operating at several levels (SPOKE, SPOKE affiliates, and HUB founders) on RAISE activities with a relevant commitment in terms of co-funding and effort.

As previously mentioned, Regione Liguria has been actively involved in the activities since the early stages, collaborating in the definition of the themes and maximising the coherence of RAISE with the regional S3 and with the socio-economic development objectives of the territory. A specific presentation of RAISE and its objectives was made to the Regional Council of Liguria. Lastly, the Regional Council, through a specific act (attached), approved the participation in the HUB together with its in-house companies FILSE and Liguria Digitale, which will guarantee the contribution to the ecosystem through the provision of specific services at the service of the ecosystem (support for the management of calls within the framework of RAISE cascade funding) and the provision of infrastructures (incubators, infrastructures, and digital platforms). Within the framework of local institutions, the Genoa City Council (through its Job Centre company) and ANCI Liguria participate in the HUB with functions of guidance and identification of specific modalities and places for testing the technologies developed within RAISE. Indeed, all the subjects involved have a significant operational role within the ecosystem and have shared strategic choices in all the phases of the definition of the proposal, committing themselves to pool their competences and skills. It should also be noted that the Advisory Board of the HUB, which will be made up of the aforementioned players of the regional research and innovation network (<https://servizi.regione.liguria.it/page/welcome/openinn>), will create a strong and constant link with a very high number of large enterprises and SMEs, as well as with numerous players representing the civil society of the region.

In addition to the described ways of involving ecosystem actors, RAISE has defined an involvement plan for SMEs and described it in the framework of SPOKE 5 activities.

In particular, about 20% of the resources will be earmarked for three waves of open calls (accelerator grants, POC) to finance SMEs on R&I projects in the relevant sectors with the aim of supporting the competitiveness of the economic system and creating stable synergies with the ecosystem (participation in living labs, use of tools, instruments,

technologies developed by RAISE). In addition to this, many of the activities envisaged in Spoke 5 concern support services to start-ups and SMEs outside the ecosystem for POC, feasibility studies, test before invest activities.

All RAISE Open Calls will aim to stimulate, inspire, and support innovation experiments and industrial challenges that meet user needs and have clear market potential with important benefits for the regional economy and society. The RAISE Ecosystem aims to use the mechanism of Open Calls providing financial support to third parties to accelerate network expansion, driven by the AI and robotics community. Under the RAISE framework, the Open Calls will aim to

- support industry, in particular SMEs of the ICT/Engineering/biomedical sectors, in their digital transformation, through demonstrators and platforms development, technology transfer experiments, and other services;
- allow the RAISE Partners to benefit from the opportunities of guiding, supporting and teaming up with start-ups and SMEs from the robotics and AI sectors;
- mobilize private matching funds (e.g., acquisition by big industrial players, corporate Venture Capital investments) that will support the scale-up of AI and robotics technologies and will accelerate the digital transformation for the activities developed within each RAISE spoke. Training activities will also partly target SMEs outside the ecosystem with the aim of reducing the skills mismatch.

The open innovation platform, which will be set up in the first months of the project, is a fundamental tool for the engagement of SMEs at territorial and national level, as is the already planned collaboration with Innovation Poles and Technological Districts to which over 400 SMEs and numerous large enterprises outside RAISE are associated.

Finally, as part of the SPOKE 5 activities, a mentor companies' network and an investor network will be set up to mobilise private resources for start-ups and SMEs to exploit and bring to market the technologies developed under RAISE activities.

### ***3.9 Type of data and qualitative-quantitative indicators proposed for monitoring activities and for ex-post evaluation***

As outlined in Section 3.4, a specific monitoring and evaluation program will be developed to support the quality and effectiveness of the actions of each spoke and of the entire ecosystem. We conceived and designed a monitoring and performance measurement system for the spoke supervisor to report on any deviations in the implementation and execution of the strategy and at operational level. The program manager - supported by the project management office and a dedicated Risk Manager - will then be able to regularly monitor the progress of all activity streams, identify potential risks at an early stage and implement mitigation or corrective actions. The ecosystem project was created to foster the technology transfer system and impact, at the local, national, and international levels, starting from a clear technological focus that is identified in the thematic spokes. The foundation of the ecosystem is high-potential applied research (medium-high TRL), the resulting technologies will hit the market in a well-known path, below represented, where each stage and milestone has associated performance indicators.



The translational path includes indicators on the quality of research, the exploitation of research and several indicators measuring the capacity of the technology transfer process. A view shared with the Joint Research Centre of the European Commission's Science and Knowledge Service is that patenting is an artificial measure of activity, in the sense that patents are important but that they are often misused as indicators. Therefore, the ecosystem will use a set of legacy quantitative indicators that will provide anchorable performance parameters, but other qualitative indicators will build experience curves and measure impact performances providing meaningful information to the project management and risk assessment. Technology transfer is always accompanied by a transfer of knowledge both at the company level with a transfer of confidential information and at the training level. In addition, the investigated technologies we study and try to bring into society will have a crucial impact on our society and should therefore be effectively communicated in order to generate awareness of their responsible and ethical use. Therefore, the measurement considers different aspects and many stakeholders and targets with different customer journeys.



From a quantitative point of view, we will collect legacy indicators following the path of technology transfer:

KPI families				
Research and development	Training	Public engagement	Technology transfer	Attractiveness and collaboration
Scientific publications number and score	Number of educational, training and dissemination events		Invention disclosures, patents, licenses	Growth of the number of researchers involved
Number of industrial doctorates		Number of living/joint labs	Number of start-ups and connected investment	Growth of the number of women in the ecosystem
Number of research contracts and connected projects			Funding rounds and investment	
Number of calls launched			Integrated financial leverage (annually)	

The indicators proposition takes into account best practices and recommendations at European level on the evaluation of R&D programs, knowledge transfer and public engagement<sup>23</sup>. Understanding and measuring impact is critical and the ecosystem remit and function include innovation and impact. Impact is both societal and economic. The following qualitative indicators are deliberately limited in number to those for which it should be possible for the ecosystem to drive. How the information can be captured and relayed, combined with the challenges are described.

Core Indicators	Commentary
Jobs created in spinoffs	RAISE will need to retain the relationship with the spin-off and/or actively monitor public information. Data harder to access/interpret when a spin-off is acquired.
Aggregate investment in spinoffs	RAISE will need to retain the relationship with the spin-off and/or actively monitor public information. Data may be difficult to access as company and investors may wish to keep confidentiality.
Products on market	RAISE will need to retain relationship with the spin-off or licensee company and/or actively monitor public information. Data harder to access over time due to causality — as the company will often not recall the source of the IP. Easier to collect where the Product is linked to a royalty stream.
Culture change in RAISE	Indicators could include: 1. Percentage of researchers engaged (and change over time) 2. Net promoter score for engagement 3. Prominence of R&D, KT and public engagement in RAISE strategy 4. % of return on investment for KT
Societal benefits	Best captured through evidence-based case studies. In addition to IP and technology-based outcomes, many benefits are generated through gaining new knowledge, for example impact on new products or process (pollution, costs, hazard etc); impact on policy; healthcare interventions etc. In many cases, the outcomes are a result of access to technology and new knowledge.
Economic Benefits	The broader economic benefits are challenging to capture and will often require externally commissioned expert support. Usually, such studies are lengthy and expensive and rely on assistance from the companies and other non-academic “users”. But such studies which may demonstrate Economic Value Added (EVA) and job creation within a region or country can be powerful. They should be undertaken on an occasional basis.

The joint analysis of quantitative indicators and the collection of qualitative indicators will give a comprehensive picture of the impact of the ecosystem, steering the development path and calibrating the strategies, tactics and actions to achieve economic, social and environmental sustainability in the medium and long term.

<sup>2</sup> Campbell, A., Cavalade, C., Haunold, C., Karanikic, P., Piccaluga, A., Knowledge Transfer Metrics. Towards a European-wide set of harmonised indicators, Karlsson Dinnetz, M. (Ed.), EUR 30218 EN, Publications Office of the European Union, Luxembourg, 2020, doi:10.2760/907762, JRC120716.

<sup>3</sup> ASTP 2019 Survey Report on Knowledge Transfer Activities in Europe

Consistent with these KPIs, quantitative result indicators have been included in section 2.1.3 to which the SPOKES contribute through the achievement of the specific objectives described in Section 3.4.1.

## 4 PROGRAM IMPACT

### 4.1 Introduction

The reporting of the results, outcomes, and impacts generated by the programme is an extremely important phase that aims at assessing qualitatively and quantitatively in the short, medium, and long term the effects of the activities envisaged by the various spokes and their interaction. The impact assessment is presented here starting from an overall assessment of the contribution of the ecosystem in bridging the gaps defined by the PNRR and other national and regional programming frameworks. Subsequently, a detailed analysis is proposed on the individual spoke.

Necessarily, impact analysis at this stage takes the form of a three-step ex-ante evaluation: firstly, the programme's impact areas are identified; secondly, it identifies the programme's impact in the previously identified areas; finally, it operationalizes the impact through indicators and metrics useful for monitoring and evaluating the ex-post impact. Some of these impacts will be identifiable through direct output measurements while others, especially in the sphere of social and cultural impact, are not directly observable or measurable, such as, for example, subjective impact assessment and perception and human capital enrichment.

Specifically, Section A of the proposal identifies, through a specific context analysis, the positioning of RAISE in the reference territory. On the one hand, the strengths and leading technological vocations of the region are highlighted, which have motivated the choice of the technological focus on robotics and artificial intelligence, on the other hand, the gaps that RAISE intends to fill through its actions.

The strategic choices underlying the structure, actions and objectives of RAISE are also fully in line with the criticalities identified in PNRR, Mission 4, Component 2 in terms of skills mismatch, low R&D investments, low level of R&D expenditure, low number of researchers and loss of talent, reduced demand for innovation, limited integration of research results in the production system.

The identification of impact areas and their measurement is therefore aimed at "measuring" the effectiveness of the ecosystem in mitigating the above-mentioned criticalities at regional level, thus contributing to achieving the PNRR challenges. Furthermore, the programme contributes in different ways to implementing the overall PNRR strategies (digitisation and innovation, ecological transition and social inclusion) through the action of all the spokes (as represented in Section 3).

### 4.2 Identification of impact areas for RAISE

Based on the foregoing, the RAISE program aims to develop an effective and efficient innovative ecosystem; to do so, it must guarantee the adoption of such an R&D approach as the Responsible Research&Innovation one, centred on the users' needs and the Open Innovation Approach, based on extensive collaborations amongst the main actors of the innovative process. These are precisely the approaches adopted by each spoke (from one to four), in which R&D activities are carried out through extensive collaborations between public and private research centres and users' involvement.

Further, to satisfy the requirement of PNRR Mission 4, component 2 (from research to market), a thorough knowledge transfer activity aiming to maximise the two-way flow of technology, IP and ideas from research labs to the market must be carried out, under the responsibility of the spoke 5.

The expected impact of RAISE depends on the following:

- Effectiveness of research carried on within spokes 1 to 4
- Effectiveness of knowledge transfer activities carried out by spoke 5

An ecosystem is effective when all the macro-categories of key actors (research centres, firms, governments and public administration, users) may benefit from the activities.

Adopting a territorial perspective, an ecosystem is effective when it contributes to removing weaknesses and, at the same time, improving strengths, building on the latter to promote the transition towards a better future.

A challenge when considering indicators is that quantitative indicators, such as financial data or intellectual property assets, are insufficient to describe the complexity of knowledge transfer and commercialization processes and their longer-term impact. This is recognized by the major international Knowledge Transfer associations. Taking this into account, we are now going to describe first the expected benefits for main targets deriving from the RAISE program

realization; then, we will individuate the most appropriate quantitative indicators for an impact evaluation, considering economic, social, and environmental effects of the ecosystem as a whole.

#### 4.2.1 Qualitative assessment of benefits for RAISE stakeholders

RAISE is set to develop an active innovation ecosystem around Robotics&AI technologies, to support the innovativeness, economic and social development of the Liguria Region. More specifically, the program focuses on industrial and service activities characterizing the regional economic specialization (i.e. ports, transport and logistics) as well as on sectoral areas that can benefit greatly from technology applications and research results (i.e. health, energy, urban context...). To this regard, the following table reports the main benefits for the main target groups resulting from RAISE activities:

Benefits for stakeholders	Qualitative description of main benefits
SMEs	<ul style="list-style-type: none"> <li>▪ Access to a specialized ecosystem for knowledge exchange, training, and technology transfer</li> <li>▪ Access to acceleration services for existing innovative SMEs with radical solutions (strategic and financial support)</li> <li>▪ Access to networks and opportunities to link with large companies</li> <li>▪ Removal of barriers to innovative technologies adoption (strategic support)</li> <li>▪ Potential collaboration with research laboratories</li> </ul>
Large Enterprises	<ul style="list-style-type: none"> <li>▪ Facilitated access to technological breakthroughs</li> <li>▪ Access to specialized knowledge and talents</li> <li>▪ Collaboration with University for training courses on specific expertise</li> <li>▪ Strengthening the positioning in reference markets</li> <li>▪ Opportunities to identify innovative SMEs for co-development projects</li> <li>▪ Opportunities to link with startups</li> </ul>
Financial Institutions	<ul style="list-style-type: none"> <li>▪ Early access to technological opportunities</li> <li>▪ Scouting and financial support to innovation projects</li> <li>▪ Identification of new ventures and support to start-ups</li> <li>▪ Valorization of their investment tools</li> <li>▪ Development of new investment instruments at local scale in concert with local government authorities</li> </ul>
University & Research Centers	<ul style="list-style-type: none"> <li>▪ Access to specialized knowledge transfer services</li> <li>▪ New and improved collaborations with other research groups in the field of action</li> <li>▪ Strengthening relationships with large firms adopting an Open Innovation approach to R&amp;D</li> <li>▪ Deliver training and dissemination activities within the ecosystem</li> <li>▪ Access to investors to launch spin-offs and start-ups as an outcome of the research activities</li> <li>▪ Renovation of Educational and Innovation offerings</li> <li>▪ Higher attractiveness for new students</li> <li>▪ Enhancement of tools and instruments supporting a Responsible Research and Innovation (RRI) approach</li> </ul>
Public Authorities	<ul style="list-style-type: none"> <li>▪ Access to RAISE services and infrastructures to address key challenges in health, energy, port, urban and territorial management</li> <li>▪ Innovative solutions to reach policy targets</li> <li>▪ Adoption of new processes to improve the efficacy and effectiveness of current activities</li> <li>▪ Increased opportunities to reduce the territorial imbalance</li> <li>▪ Increased attractiveness of the regional territory</li> <li>▪ Guidance and advice to strengthen the regional economy</li> </ul>
Citizens	<ul style="list-style-type: none"> <li>▪ Increased awareness of Robotics&amp;AI potential impacts</li> <li>▪ Increased opportunities for innovative services</li> <li>▪ Increased opportunities for participation in innovative processes through co-creation activities</li> <li>▪ Enhancement of education and training opportunities</li> <li>▪ Higher attractiveness for young researchers</li> </ul>

#### 4.2.2 Quantitative assessment of RAISE impact

As regards the impact of the RAISE program, we must consider direct as well as indirect effects.

More specifically, the *direct economic impact* is measured against industries closely related to the project's R&D activities, i.e. logistics and transport, health, personal services, energy (mainly involving the service sector). It is therefore expected an increase in the turnover of companies operating in the sectors indicated, an increase in staff qualifications, an increase in the survival rate of new companies, higher foreign direct investments.

There are also *indirect effects* to consider, i.e. positive effects spreading throughout the regional territory, as recalled in paragraph 1. They foster the macroeconomic performance of the regional economic system.

Further, social as well as environmental impacts are expected, as indicated in the following table (table 2). The chosen indicators are mainly based on official statistics (Eurostat, Regional Innovation Scoreboard, etc. ....), as this enable us to set up a monitoring system effective and at a low cost. Notwithstanding, some indirect effects require a specific approach, i.e. surveys carried on systematically, to highlight if and in what manner the expected results have been realized. These indicators are in red in the table below.

**Table 1 Potential impacts and related indicators**

Potential impact	Main indicators
Economic	% new jobs in robotics and AI
	% new products/services in robotics and AI
	Number of new startups in Robotics&AI
	Turnover
	Profit
	R&D expenditure business sector
	R&D expenditures public sector
	R&D expenditure per person employed
	Innovative SMEs collaborating
	% employed ICT specialists
	Employment knowledge-intensive activities
	% turnover from new product/services
	Net business population growth - percentage
	Business churn: birth rate + death rate - percentage
	Birth rate: the number of enterprise births in the reference period (t) divided by the number of enterprises active in t - percentage
	3-year-old enterprises' share of the business population - percentage
	Employment share of 3-year-old enterprises: Number of persons employed in enterprises newly born in t-3 having survived to t, divided by the number of persons employed in the population of active enterprises in t - percentage
Social	New policies
	New interventions
	New & improved processes
	Internal Culture Change in PROs
	Safety
	Health
	Comfort
	Tertiary education
	Share of PhDs employed
	Lifelong learning
	Above-average digital skills
	Citizens' awareness about Robotics&AI
	Research & Educational system attractiveness
	Female rate participation in STEM educational programs
People at risk of poverty or social exclusion	
Net immigration in inner areas	
Reduction in village abandonment	
Environmental	Amount of GHG emissions
	waste
	resource depletion (water, marine resources etc.)
	amount of energy consumption
	sustainability of electricity supply

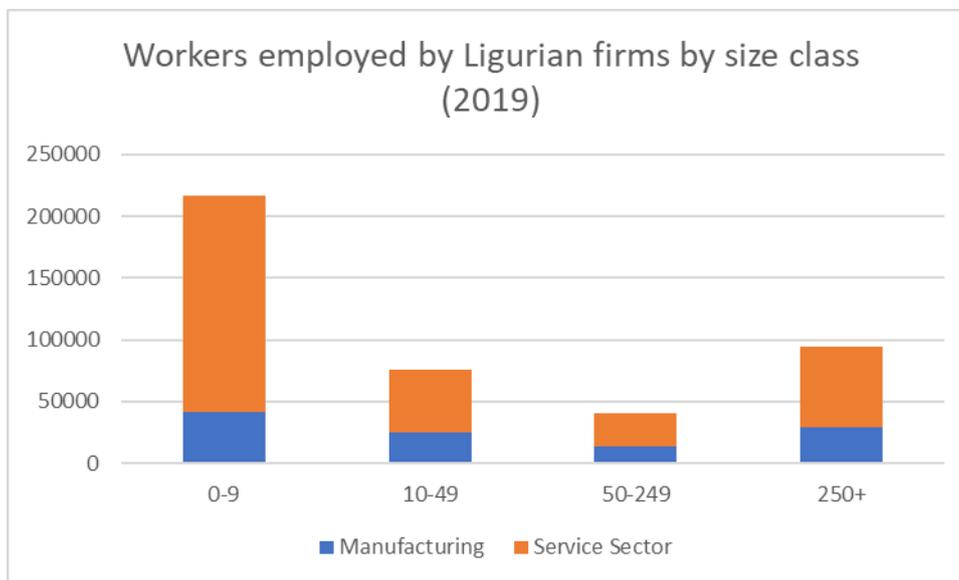
The on-going and ex-post evaluations of the impact of the project will be done under a multi-criteria perspective in order to take into account the different goals that the activities (project's tasks) are intended to pursue as well as the different dimensions of the impact (economic, social and environmental).

Moreover, the monitoring of the impact of the project will also be developed in a territorial perspective (by compiling distributive matrices) to highlight how much of the impact will affect the coastal areas and how much the inland areas, the capital cities (where the few large companies in the region are concentrated) and the smaller centers, the densely populated areas. This will provide a measure of the ecosystem's capacity to foster the territorial cohesion in response to the region's weaknesses found in the context analysis.

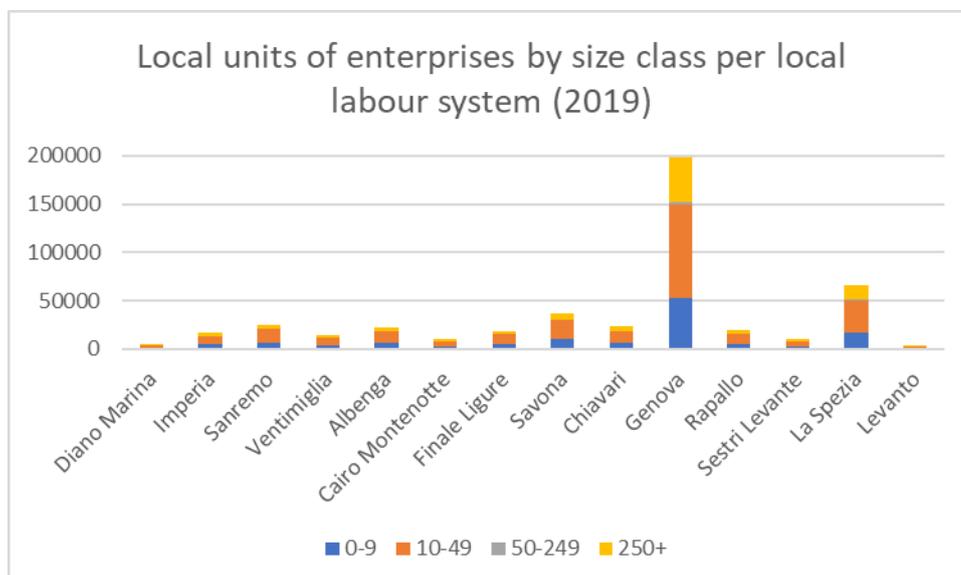
### 4.2.3 The role of Small & Medium Enterprises in Liguria

According to the most recent data released by Istat, in Liguria in 2019 Small & Medium Enterprises (SMEs) represent 99.93 of the overall enterprises recorded. In particular, firms with less than 10 workers represent 95.90% of all Ligurian enterprises. Figures change when employment is considered, anyway SMEs concentrate nearby 3 quarters of the overall workers employed and firms with less than 10 workers employ half of the regional employees.

These figures do not change significantly even when distinguishing between the manufacturing and service industries or breaking down data for the 14 local labour systems of the region: Liguria is confirming itself as a region with a productive structure based on small and very small enterprises.



Source: Istat



Source: Istat

The above-mentioned figures clearly show how the effects of the interventions foreseen by the project can have an impact on the SMEs located in the region, increasing their competitiveness and contributing to limit (if not to cancel, at least in part) the negative effects typical of small business size and enhancing the flexibility and openness to innovation typical of innovative start-ups.

### 4.3 Contribution of the SPOKES in bridging the gaps defined by the PNRR

The effort to relaunch Italy outlined in the PNRR is developed around three strategic axes shared at the European level: digitisation and innovation, ecological transition and social inclusion.

Regarding the first axis of digitisation and innovation, Italy has accumulated a considerable delay in this field, both in terms of citizens' skills and in the adoption of digital technologies in the productive system and public services. As far as the digital transition is concerned, the Plans must devote at least 20 per cent of the total expenditure for investments and reforms to it. The aim is to improve digital performance as summarised by the Digitisation Index of the Economy and Society (DESI) and the objectives outlined in the Commission Communication "Designing Europe's digital future". The digital skills of citizens and workers must increase, as must their ability to access digital tools and services, particularly for vulnerable social groups. The plans must contribute to implementing the European Pillar of Social Rights about its dimensions of equal opportunities and access to the labour market; fair working conditions; access to health care; and social protection and inclusion. The plans should promote a change in labour policies, also to facilitate and accelerate structural changes such as green and digital transitions. The fourth pillar is social and territorial cohesion. The Plans strengthen cohesion and reduce local, regional and urban-rural disparities. They must also address general challenges related to gender and income inequalities and demographic trends.

The programme contributes in different ways to implementing the PNRR strategies through the action of all the spokes (see following table).

**Table 2 Programme contribution to PNRR actions**

Mission	Spoke 1: Urban technologies for inclusive engagement	Spoke 2: Smart devices and technologies for personal and remote healthcare	Spoke 3: Sustainable environmental caring & protection technologies	Spoke 4: Smart and sustainable ports	Spoke 5: An engine for knowledge and technology transfer
M1. Digitalisation, innovation, competitiveness, culture and tourism	✓	✓	✓	✓	✓
M2. Green revolution and ecological transition	✓		✓	✓	✓
M3. Infrastructure for sustainable mobility	✓			✓	
M4. Education and research					✓
M5. Inclusion and cohesion	✓	✓	✓		✓
M6. Health		✓			

#### 4.3.1 Identification of impact areas for Spoke 1: Urban Technologies for inclusive engagement

The evolution of the city has seen from time-to-time new urban populations appear on the scene, that is, large groups of individuals who frequent the city to varying degrees to carry out equally different activities. Currently we have reached the third-generation cities in which four types of urban populations can be identified: residents, commuters, city users

(e.g., tourists) and businessmen. These four populations, while showing some common characteristics, carry out activities and reveal substantially different behaviours that urban management cannot, or should not, ignore. The National Research Program of Italy for 2021-2027 (PNR 2021-2027) makes a significant statement at this regard, indicating human-centred innovation as one of the program's priorities. Spoke 1 goals are fully in line with this national priority and aim at building technologies which serve individuals in the interaction among themselves and with the city services. The innovation pursued by spoke 1 is expected therefore to impact at the societal and at the economical levels.

At the societal level, all the technologies addressed will serve specific requirements/needs of individuals that have recognized barriers that limit or constrain their level of engagement with the city. The impact of the technologies built for this scope will be assessed in detail, as specified by the spoke 1 program, by using an appropriate methodology, however, we anticipate that the impact will be measured qualitatively against the number of associations that the Living Labs will be able to attract, the number of individuals engaged, the services and/or devices that will be tested and experimented in the urban areas, the diffusion in the territory of Living Labs, and the capacity of influencing local policy-making. At the regional level, we expect a high impact of spoke 1 in the Silver Economy sector, whose relevance has been recently recalled by the constitution of the Ligurian “Silver Economy District”, an agreement signed by Regione Liguria, UniGe, Genova Municipality and Chamber of Commerce to give specific recognition to this field of economical and societal development. Regione Liguria has been recognized as a European reference site for Healthy and Active Aging thanks to the existing ecosystem of national, regional and local authorities, hospitals and public research bodies, as well as associations of the Third sectors and ICT-related small-medium enterprises able to turn the healthy and active aging into social and economic value. Spoke 1 has the ambition to generalize the leadership of the Ligurian territory and create a regional leadership in assistive technologies for inclusive urban design and management.

The spoke outcomes will be matched to SRL-Societal Readiness Levels, as suggested by the PNR 2021-2027, and as recalled by the PNRR goals and missions. In particular, the impact of spoke 1 will influence the following PNRR missions, in order of importance: M5C2 social infrastructures, families and third sector (strengthening the role of territorial social services as resilience instruments, aiming at personalized care models for families, teen-agers and elderly, as well as for impaired); M1C3, Tourism and Culture 4.0 (enhance cultural experience and touristic accessibility through digital investments and investments aimed at overcoming physical and cognitive barriers); M4C1, strengthening the scientific, technological and linguistic competences of teachers and lecturers, with focus on communication and problem-solving capacity.

At the economical level, the envisaged network of sensors and devices will boost technological competitiveness through the realization of innovative AI-guided robotic technologies and IoT smart city solutions that will act as attractors not only for big enterprises and SMEs (for solutions at high TRL) but also spin-off to test in a real-city settings technologies under development (medium TRL). This will improve local employment opportunities and skills, the appeal of the city for residents, tourists, and companies, and will enhance creativity and innovation. We foresee a high impact of spoke 1's outcomes on the development policies of the sustainability of urban areas, thanks to the infrastructure of AI-driven services able to provide real-time knowledge of the state of well-being of the population and the state of the indoor and outdoor environment. The huge amount of information provided by the sensors network is envisaged to boost the development of tools for the city administration for control and timely intervention on outdoor and indoor environment (e.g., public buildings), and will call for investments in high-speed connectivity (5G and beyond) to for Spoke 1 will contribute to PNRR missions, in order of importance: M1C1 – Digitization, innovation and security in the Public Administration; M1C2, Digitization, innovation and competitiveness of the productive system (high-tech investments, digital transition and ultra-fast connections).

#### *4.3.2 Identification of impact areas for Spoke 2: Smart devices and technologies for personal and remote healthcare*

Spoke 2 aims at exploiting the potential of artificial intelligence (AI) and robotics to revolutionize the current approaches for diagnosis, treatment, rehabilitation and care. AI techniques provide an unprecedented capability of extracting information from large amounts of heterogeneous data at different levels of description, to help the diagnosis and to support therapeutic decisions. Robots are increasingly complementing human operators in once labour-intensive activities, like physical therapy and personal care, or in surgical procedures which require high levels of dexterity and great precision and minimal invasiveness. On the other hand, robotic systems are being designed for human-sensitive interactions with the patients, providing them with valuable services according to their needs of care and support.

The next generation of healthcare technologies developed within Spoke 2 will provide novel approaches promoting *prediction, prevention, and personalization* toward a continuity of care paradigm, where quality of care over time will

be assured by delivering a 'seamless service' through interconnection, integration, coordination and the *sharing of information* between *different facilities and providers*.

In general, these objectives are in line with the [Strategy for Technological Innovation and Digitisation of Italy 2025](#) and the [Digital Strategy for Digitisation and Innovation of Regione Liguria](#).

More specifically, the newly developed technologies will leverage innovation in healthcare systems at both regional and national level. At regional level, technological advances in intelligent and interactive environments (WP1), digital twins (WP2), rehabilitation ecosystems (WP3) and future diagnostic imaging (WP4) will find an immediate application in a number of strategic programs of the regional government of Liguria in the healthcare domain, such as the *digital home care telemedicine*, focusing on remote monitoring of chronic/elderly patients, specialist teleassessment (doctor-patient), tele-cooperation (doctor-healthcare provider-patient), and teleconsultation (doctor-doctor). Digital Twin technologies (WP2) will also leverage several strategic projects, such as the enrichment of *Electronic Health Record (EHR)*, *Patient Relationship Management (PRM)*, and the *Telemedicine* initiatives. The newly developed technical solutions, research infrastructures and multi-disciplinary competencies will also serve as substrate for the future clinical and research activities of the [new hospital concept](#) – with a focus on biomedical technologies and computational medicine – whose construction is planned in the city of Genova (Erzelli area).

The economic and social impact of Smart Devices and Technologies for Personal and Remote Healthcare is extremely significant and only partly directly measurable. A brief description of the main expected impacts is given below:

1. Technological advances from local to international markets. Technological advances in healthcare are the ultimate effect of the interaction between developers, patients and doctors, aimed at improving the effectiveness of tools and making them easier to use. Spoke 2 activities will provide solutions and devices that take into account all these different aspects, through (i) boosting the development of novel devices and enabling technologies; (ii) *advancing the technology readiness level* of several med-tech devices that consortium members have been developing in their respective research subfields; and (iii) *improving existing commercial solutions* produced by SMEs and large companies.

The presence of both well-established large companies and SMEs in Spoke 2 will favour *business opportunities* across the *med-tech market at local and international level*. We will also explore markets not directly related to healthcare technologies, such as non-healthcare robotics, intelligent vision systems, AI-based monitoring solutions, for further exploitation. Spoke 2 aims to uplift the future position of the Ligurian industrial actors as *leaders in healthcare technologies*, contributing to a significant increase in *attractiveness*, overall *healthcare quality* and direct *investments* in the local healthcare industry and research.

2. **Improved individual and societal resilience.** The development of cutting-edge devices and technologies and the future commercialization of the solutions developed by this Spoke will bring *added value* to National hospitals and healthcare services, to the benefit of Ligurian and Italian citizens. Spoke 2 advances will lead to technological and process innovations in healthcare systems at both regional and national levels, which will have a significant impact on *cost reduction and improved quality of care* [3].

For instance, newly developed Digital Twins may lead to improved medical education and training, Health Technology Assessment (HTA), and the identification of *user centred, more efficient and safer health policies*. For instance, these technological solutions will reduce the disparities in healthcare quality, by providing quality healthcare for residents in inland areas which are further away from major hospitals. Connected care platforms for precision medicine and decentralized healthcare will also bring important benefits to individual users, in terms of improved health and quality of life. The Smart Devices and Technologies for Personal and Remote Healthcare developed in Spoke 2 will also contribute to reducing patients' and caregivers' health-related travel. Up to 20% of specialist visits might be conducted remotely, saving chronic patients 48 million hours of travel time – 66 million when accounting for caregivers (*Digital Innovation Observatory, Politecnico di Milano*). The possibility of reducing the travel of frail patients is therefore a clear impact that does not expose them to additional risks, reduces the economic cost of travel, generally borne solely by the patients, the social burden of caregivers (frequently women who are forced to balance work and assistance to the elderly), the environment, for the reduction of emissions in travel and an overall improvement in the quality of life of the patient who, being monitored and stimulated to adhere to the therapy, follows more effective medical paths.

Although Spoke 2 activities will not directly affect the healthcare systems within the project time span, collaboration of research institutions with industries and clinical institutions will enable the experimentation of

devices and solutions in a variety of clinical populations. Data on patients and therapists experience will provide valuable information to predict the overall impact of these solution at the level of the whole healthcare systems.

#### 4.3.3 *Identification of impact areas for Spoke 3: Sustainable environmental caring & protection technologies*

The European Green Deal aims to improve the well-being and health of citizens and future generations through actions covering different sectors from climate to agriculture through a secure and affordable EU energy supply, considering the environment as a source of natural and economic wealth. In this context, The new 2021 EU strategy on adaptation to climate change sets out how the EU can become climate resilient: adaptation actions must be informed by robust data and risk assessment tools that are available to all – agencies safeguarding the territory, businesses in coastal regions and farmers planning their crops. The UN Decade of Ocean Science for Sustainable Development recognizes that urgent actions are required to maintain a life-supporting ocean and ensure adequate protection and adaptive management of the marine environment. The same applies for all strategies of soil protection. Relevant examples are the harmonization of methods for landslide mapping and zoning in Europe (inventory, susceptibility, hazard and risk) at various scales, development of satellite, airborne and ground-based remote sensing techniques for landslide mapping and long-term monitoring, analysis of lessons learnt from management of past landslide disasters, and geospatial database creation and management. Finally, the European objectives for 2030-2050 aim for a progressive and complete one decarbonisation of the system ('Net-Zero') and strengthening the adoption of circular economy solutions to protect nature and biodiversity and ensure a fair, healthy and respectful environment. All these EU objectives are well matched by the SPOKE 3 - Sustainable Environment Caring and Protection Technologies, which declines them in the context of the peculiar and fragile Ligurian ecosystem.

Sustainable management of the environment requires an environmental observing system that delivers fit-for-purpose information serving governments, societies, sustainable economy, and citizens, leading to better monitoring and better forecasting, crucial for a smart management of the land, coastal and marine environment including exploitation, valorization and protection.

Specifically, SPOKE 3 will develop a series of methods and tools ranging from autonomous robots, intelligent bio- and bio-inspired-sensors, AI-based technologies for envisioning, planning and actuating new strategies for a sustainable management of the territory.

Spoke 3 will consider requirements from important end-users and stakeholders such as governments and regulatory bodies (e.g. environmental agencies), governmental frameworks (e.g. SDG14, UNFCCC, MSFD); the aqua/agriculture and energy sectors, coastal and port managers, and citizens. Spoke 3 will optimize the observing and forecasting systems in a process of co-design and stakeholder dialogues. This will guide the design and implementation of operational services exploiting real-time data and modeling strategies via state of the art and novel AI based algorithms and robotics solutions. The Spoke envisions a truly interdisciplinary decision support system for the wellbeing, growth and sustainable management of the environment. The expected impacts include to:

- lay the foundations for / contribute to the sustainable management and protection of marine, coastal and terrestrial ecosystems, mitigating adverse events (e.g., landslides, floods).
- Improve the forecasting of extreme events of weather/ocean conditions for protecting human activities.
- Increase scientific knowledge, develop research capacity and transfer new technology.
- Shorten the time span between research and innovation and foster economic value in the sustainable economy.
- Achieve at least TRL 8 for ecosystems services and tools. The Spoke 3 will enhance the current technology readiness of both observing and forecasting technologies.
- Improve the professional skills and competencies of those working and being trained to work within the Spoke 3 ecosystemic economy and in the context of open data sharing.
- Contribute to policy making in research, innovation and technology.
- Improve Innovation Capacity by means of cooperation between commercial (including SMEs) and academic partners.
- Create new market opportunities, strengthen competitiveness and growth of companies.
- Offer important benefits for society.
- Help ecosystem actors to be worldwide innovators and leaders.

The ecosystem proposes to expand monitoring systems to support Liguria's policy in the context of the complex European Marine Strategies (GreenDeal, NextGeneration Europe, Sustainable Development Goals - Paris Agreements,

MSFD, MSP, WFD). It also proposes to innovate bio- and bio-inspired, autonomous robots, federated stand-alone systems based on technologies and services that transform them into a coordinated ecosystemic-network with associated data transmission and management, data analysis, AI, ML and IT services for their access and use. The spoke aims to contribute to the several social objectives: 1) To improve the predictions of climate change and climate and their effects on coastal communities; 2) Improve the safety and efficiency of maritime operations; 3) Reduce the effects of natural hazards; 4) Improve port security; 5) Reduce the risks threatening the public health; 6) Protect and restore ecosystems; 7) Enable the sustainable use of resources; 8) Move towards a Zero emission Environment.

- **Economic impact on SMEs.** Ligurian ICT SMEs are constituted around valuable IPRs, often as a spin out action from a R&D project and, latest studies indicate an important growth (5-10%) for the entities working in the Digital/Data/AI market. SPOKE 3, as a framework in which SMEs can use, deploy and demonstrate services, represents a crucial showcase to promote and sell their assets. It is designed to involve and have a big impact and boost on SMEs. This is pursued in several ways: SPOKE affiliates include and use SMEs technologies; SPOKE affiliates develop new IPRs spinned out by license agreement or set up new SMEs; SMEs owning IPRs that improve services/tools to develop SPOKE goals may be acquired/become part of a bigger/holding group; SMEs can have tutorship from affiliates; SMEs become part of a business network.
- **Improvement of individual and societal resilience.** The Italian PNRR clearly indicates how crucial it is to act to mitigate climate and global changing trends. The need for a radical ecological transition towards complete climate neutrality and sustainable developments cannot wait any longer. SPOKE 3 is specifically addressing actions to mitigate threats to natural and human systems. The overall goal is the development of an ecosystem that brings together tools and services to monitor, evaluate, assess, process, distribute environmental data from many disciplines (natural science, human activities, tourism, production, recreation, etc.) into an integrated expert platform that supports decision making, strategic planning, remediation actions, warning systems, education towards a sustainable and zero emission Environment. Developing an ecosystemic approach to environment care includes a strong societal participation that pushes for a fundamental individual and societal resilience. Sustainable environment services and production mean new jobs, higher education, proactive participation in the public care, high attractiveness of the region, etc.
- **Cost reduction.** Since 2013, the Italian Regional Administration notified more than 20M€ of damages due to environmental extreme events. According to Ban Ki-moon (UN Secretary General): "We cannot ignore the importance of these figures. Economic losses due to disasters are uncontrollable, they can only be reduced thanks to partnerships with the private sector, including the banks and insurance companies. For too long, markets have sought short-term profits at the expense of resilience and sustainability. Eventually they must understand that reducing exposure to catastrophe risks is not an additional cost but, on the other hand, on the contrary, an opportunity to increase the profitability of long-term investments ". SPOKE 3 is developing an ecosystem that brings together innovation, education, technology transfer, bio- and bio-inspired devices and sensors, autonomous robots, AI and ML to organize a distributed, semi-automatic environmental monitoring, caring and early warning. Having a such ecosystem up and running implements the most advanced methodology and approach towards Environment Caring and Protection according which the best defense is offense (i.e. prevention and mitigation avoid/are cheaper than remediation).
- **Improved trust in and knowledge of the technology.** SPOKE 3 advocates for the use of an ecosystemic-social-technical model of trust to support agile interaction across knowledge-technology-users and to foster participation in trust-enabling interaction design. The rationale is that technological-mediated social participation needs trust, and it is with trust-enabling interactions that the SPOKE fosters the will for collaboration and sharing—the two key elements of participation. SPOKE 3 establishes a direct link between sharing and trusting, which indicates the need for providing new models and visions where trust plays an important role in encouraging sharing interactions. SPOKE 3 advocates itself to be the HUB for sharing and enabling new technologies and new services to be designed, developed, tested, deployed and adopted by public authorities, industries as well as by citizens.

#### 4.3.4 Identification of impact areas for Spoke 4: Smart and sustainable ports

As trade and cargo volumes continue to grow internationally, ports around the globe are looking to new technologies to help manage resources in a more sustainable and cost-effective manner through digitalization, big data, robotics and Artificial Intelligence. Ports are key for Italian maritime economy, in terms of national and international trade, goods and people's movement. At the same time, maritime transport is a source of growing concerns since it represents an important and growing share of greenhouse gas emissions. Ports, often located in densely populated areas, must face growing concerns in terms of social acceptance. In particular, the most critical issues are related to the emission produced

by large ships at dockside, noise, pollution and vibrations produced by the activities in the port area and the handling of goods.

Ports use digital, robotics, and AI technologies for system automation, safety and security improvements, vessel route, vessel turnaround time, and container dwell time optimization. As well as for accurate estimated time of arrival forecasts, real-time performance forecasts, and to create a digital twin of their port (a real time digital representation of the port operations). Estimated time of arrival (ETA) Forecasts Machine learning, a subset of AI when machines are programmed to replicate and imitate human decision-making processes, helps a company to create a digital simulation of what might occur in the real world.

The general expected impacts of spoke 4 are the following:

- **Improved Environmental Performance.** The high level of noise pollution affecting the areas between ports and logistic platforms represents a problem that the European Community has been trying to solve for some time now. Robotics and AI can play an irreplaceable role: the first one thanks to monitoring not only the operative port areas, but, above all the environmental quality of the port ecosystem (air, water and biota) and its sustainable relation with the city around it. Considering the possible impact deriving from and the ships hulls (outside and inside) with a valuable impact on in particular reducing pollution spilling, the alien species, pollution spilling, etc as required by international regulations (IMO). As well as, AI technologies for safety and environmental sustainability proposed by monitoring acoustic signals from the port hinterland population and port workers will introduce an efficient metric to describe the sound levels and their perception by people. Moreover, they will provide another parameter to take into account for improving the working and living conditions through adopting the most intelligent measures to enhance the acoustic quality.
- **Improved Logistic Efficiency.** The ports are ideal scenarios for applying the AI then the container movement logistics (whose automatization is the megatrend in ports of last ten years) can be exploited very efficiently. That means that a smart port is more effective, more performant, and a more economically competitive port. That efficiency will attract both private operators, which can act faster and decide to invest in the smart infrastructure needed for autonomous driving and container shipping companies. Finally, smart ports consider residents a key stakeholder of their activities. Last, but not least, the efficiency of the port depends also on the infrastructures; that will be guaranteed thanks to the monitoring with fixed and mobile sensors (using the autonomous robots) whose impact will affect will drastically reduce the expenses for inspection and maintenance.
- **Improved Relations with Hinterlands.** In spite of the complexity of the transport and logistics connection of Ligurian ports with their hinterlands, the activities of Spoke 4 "Smart and sustainable ports" have a considerable potential impact as optimizing the port functioning allows a more flexible and efficient organization of connections with the hinterlands and a corresponding decrease in the noise, vibration and pollution levels already mentioned in the environmental impacts.

Specific impacts of spoke 4 within the general ones discussed above include the following:

- Impact of uncrewed and automated systems for port automation.
- Increased Operation and Logistic Efficiency.
- Impact of aerial, ground robots and other AI & Robotics systems for port area monitoring.
- Impact of Machine Learning and real-time data for port safety, security, and sustainability.
- Impact of AI & Robotics solution for maritime tourism.
- Impact of AI methods for ports and networks optimization.
- AI-powered services for medium and small ports.

#### *4.3.5 Identification of impact areas for Spoke 5: An engine for knowledge and technology transfer*

SPOKE 5 acts, within the ecosystem, to implement all possible actions aimed at achieving the objectives defined above. For this reason, SPOKE 5 will also be responsible for the constant monitoring of the results and effectiveness of RAISE action and impact on the economic, environmental and social system of the territory.

In the description of SPOKE 5 (Section 2) and in the definition of the related tasks, the actions to be implemented and the related objectives have already been widely reported.

However, it should be emphasised that these objectives fully correspond to the priorities identified in the PNRR Mission 4 Component 2, as well as contributing to overcoming some of the structural weaknesses of the Ligurian territory.

The spoke 5 gathers the typical tools of an “*accelerator*” aimed at amplifying the economic and social impact of the technological solutions, designed and implemented within the ecosystem. The spoke “5”, in fact, aims at fulfilling the need for transferring technology and knowledge to the market, as well as providing managerial and technical training activities on human capital, so as to make the area's endowment of skills capable of withstanding the global competition. The intrinsic characteristics of the local market make it the ideal candidate site of experimentation and validation to develop products and services able of competing at an international level.

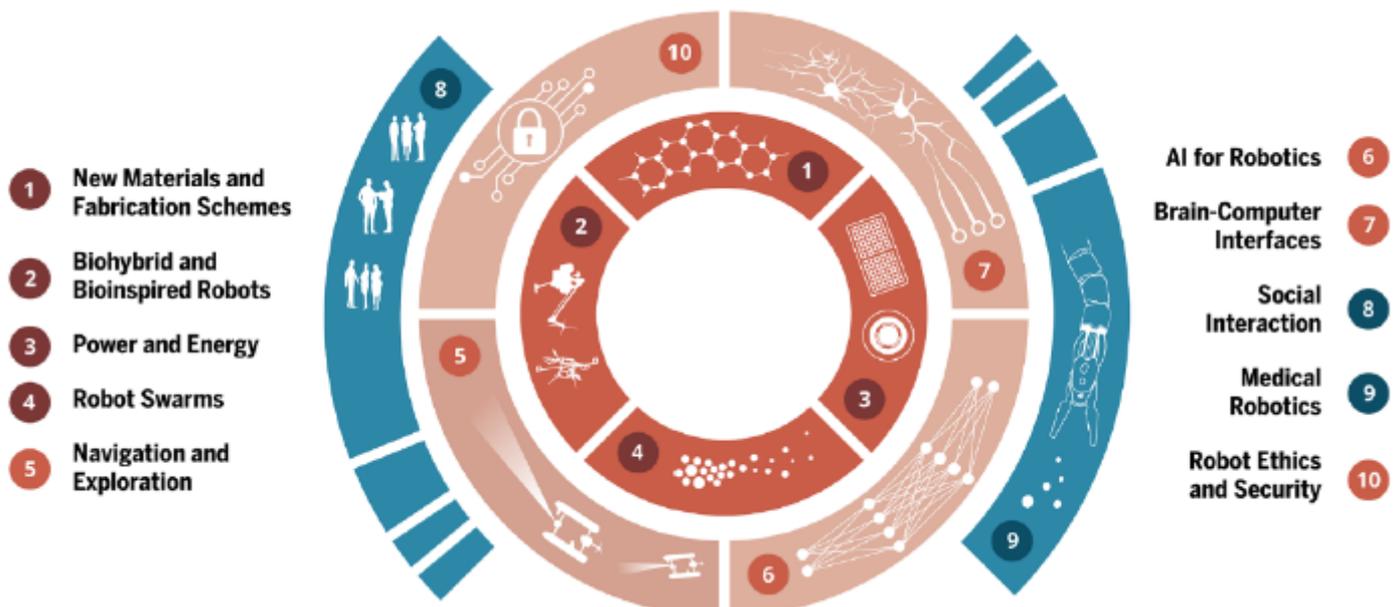
#### 4.4 RAISE program contribution to Robotics&AI development strategies

The specific impacts of the RAISE research and innovation results on the economic, environmental and social system, as extensively reported in the previous paragraphs, cannot be separated from an accurate analysis of the technological trajectories and international challenges of the two closely related pillars on which RAISE is based: Robotics and Artificial Intelligence.

The territorial effectiveness of RAISE action will be all the greater if the ecosystem as a whole will be able to intercept the main innovations and developments at national and international level in the reference sector, transforming the results of R&D projects into a lever for the competitiveness of the system.

As regards the former, remarkable progress has been made in many aspects in the last years, but some major challenges remain unsolved. The following figure shows the 10 grand challenges (Fig. 1) that may have breakthroughs, significant research, and/or socioeconomic impact in the next 5 to 10 years, as indicated by an invited online expert panel organized by the *Science Robotics* journal (Yang et al., *Sci. Robot.* 3, eaar7650 (2018):

Figure 5 The grand challenges of science robotics



As reported by the Authors, the field of robotics is wide and covers many underpinning and related technological areas. Of the 10 grand challenges listed in fig. 1, the first seven represent underpinning technologies that have a wider impact on all application areas of robotics.

The next two challenges include social robotics and medical robotics as application-specific areas of development with a huge societal and health potential impact. Finally, the last challenge is related to responsible innovation and how ethics and security should be carefully considered as technology further develops.

It is worth noting that the RAISE program addresses many of these areas, and although its time scope is three years, it can aspire to ambitions far beyond the program's time horizon.

A specific mention deserves the relationship between *Robotics&AI*: as the underpinning technology for robotics, AI is undergoing a renaissance after more than 60 years of ongoing development. Combining advanced pattern recognition

and model-based reasoning is critical for building systems that can go beyond statistical correlation and begin to reason about underlying interdisciplinary mechanisms and systems dynamics. Ambient intelligence and ubiquitous and networked AI and robotics (cloud robotics) will be critical in the development of integrated heterogeneous AI and robotic services.]

As regards *Social interaction*, Robotics and AI have often underestimated the difficulty of replicating capabilities that humans find particularly easy. Although one may argue that building social interactions for robots is premature, the practicality of putting robots into our human environments— i.e. into schools, hospitals, shops, and homes—necessitates addressing social interaction and this implies investing further in research and innovation.

As regards instead *Medical Robotics*, efforts will continue to improve healthcare in terms of both outcomes and cost. Other research and commercial efforts are focusing on what many see as an inevitable future in which intelligent robotic devices assist healthcare workers in a variety of ways. Even if many grand challenges remain, the impact of robotics on medicine is undeniable.

Increasing levels of autonomy and human robot interaction raise critical issues about potential regulatory, ethical, and legal barriers and the consideration of context of how robots are deployed.

Robotics and AI could change the workforce structure, cause a shift in the skills base, and potentially facilitate a complete de-skilling of the workforce even in safety-critical contexts: potential unemployment becomes an ethical problem, not just an economic one. The program intends to deal with these issues, dedicating specific resources to the analysis of Robotics&AI's potential negative impacts on labour and the workforce.

#### **4.5 Highlight any element of synergy of the research and innovation program, with programs financed on other investments envisaged by the PNRR (Mission 4, Component 2) and any complementarity with other national and regional program framework.**

The objectives and activities foreseen in the RAISE ecosystem have been defined taking into due account the possible synergies with the other programmes financed under the PNRR (Mission 4, Component 2) and in coherence with the relevant national and regional programmes.

The aim is to optimise collaboration and pool investments (skills and infrastructure) that can strengthen the impact of the ecosystem on the territory and its national and international positioning.

National research organisations in the ecosystem (CNR, ENEA, INGV, INFN, IIT), as well as IIT and UniGe and most of the companies affiliated to RAISE are involved in the main initiatives under the aforementioned Mission 4 (R&D National Champions, Research Infrastructures, Innovation Infrastructures and Extended Partnerships, Competence Centres and Digital Innovation Hubs): this guarantees full synergy in terms of both science and planned actions.

In particular:

National Champion (NC) HPC, Big Data and Quantum

RAISE does not focus on “computational aspects” but could highly benefit from the HPC infrastructure and services set-up by the NC. RAISE and the NC HPC find full synergy on the following topics: Digital Society and Smart Cities, Environment and Natural Disasters, Earth&Climate, In-silico medicine and omics data – impacting to RAISE spoke 2: design and develop modelling and simulation platforms for in silico trials, with the goal to provide a well-established and clear pathway of in silico medicine.

NC Biodiversity

RAISE, and especially SPOKE 3, will work in close synergy with the NC Biodiversity (project proposal involving many of the RAISE partners), on the themes of developing solutions to monitor, preserve and restore functional biodiversity, on the application of Key Enabling Technologies, such as biotechnology, artificial intelligence, robotics to identify high-tech solutions for sustainable management of biodiversity ensuring ecosystem resilience.

NC Sustainable mobility

RAISE SPOKE 4 will work in strong connection with the NC Sustainable Mobility in particular on topics concerning digitisation and sustainability of transport infrastructures (ports) and for the development of demonstrators and living labs of technological solutions oriented to the widespread application of such solutions.

## Extended Partnership (EP) Artificial Intelligence

RAISE is heavily based on AI as a key enabling technology to drive innovation: the PNRR calls for specific actions on foundational aspects of Artificial Intelligence for which RAISE could serve as a test-bed. We mention the role of CNR in the preparation of a partnership on AI that is gathering competences around research themes such as human-centred AI, real-world data AI, and pervasive AI. These entail the study of methods for developing trustworthy and explainable AI to facilitate the adoption of AI in real-world contexts (highly relevant to RAISE spoke 1 and 2), including industrial environments (highly relevant to spoke 2 and 4), and the study of hybrid AI methodologies, where model-based and data-driven approaches will be integrated (highly relevant to RAISE spoke 3). The national structure of CNR will provide a unique networking opportunity for RAISE to interact with all the groups involved in the PE on AI, offering the possibility to capitalize on the RAISE spoke activities as case studies for the foundational studies of the PE on AI.

## PE Cybersecurity, new technologies and rights protection

RAISE does not focus on “cybersecurity” as a specific topic, but the research and development actions covered by the RAISE need to carefully consider issues about security of data and data transmission. CNR, as well as other RAISE partners, are contributing as prospective Partners to an action on this theme, focusing on Data Governance, Human, Social, and Legal Aspects.

A further element of synergy of strategic importance for RAISE concerns the connections with the actions envisaged within the PNRR Mission 4, Investment 2.3 'Strengthening and thematic and territorial extension of technology transfer centres'. As already pointed out, IIT, CNR, UniGe and many of the companies affiliated to RAISE collaborate within the Ligurian Competence Centre START 4.0 (coordinated by CNR), which works to support the digitisation of SMEs through the diffusion and use of digital technologies in the fields of energy, port, transport and production systems.

The activities of SPOKE 5, aimed at encouraging and enhancing technology transfer, will be strengthened through the services and technological infrastructure of START4.0, which will be involved, together with the Liguria Digital Innovation HUB, in the Advisory Board.

UniGe is committed to PNRR Mission 4 component 1, as for Reform and increase research doctorates, ensuring a continuous evaluation of their quality. In this regard, UniGe will apply to the 38th PhD cycle compliant to DM 226 of 14-12-2021. The rector's delegate for PhD and vice rector for Research will also take care of promoting the application to the PhD programs for the Innovative PhD for companies that will be published by May 2022 (200 M€). Our applications will be aimed at strengthening the relations with the regional industries, and at creating a manifold exchange between researchers, public and private research infrastructures, and the innovation request from the territory. On UniGe side, most of the awarded grants will be carried out within the work packages of the RAISE Ecosystem. In RAISE, the Innovative PhDs will be also paired with Industrial PhDs, funded by companies, and devoted to the specific activities of the spokes. Regione Liguria will synergically contribute to the industrial research developed in UniGe with Ligurian Companies for an overall commitment of 3 up to 5 M€ for Industrial PhDs on the PON funding program along the time span of the RAISE Ecosystem initiative. This will allow UniGe to be the lighthouse of the Ecosystem in linking academic and industrial research and innovation.

The Ligurian ITS (focused on blue economy, ICT and Digital and Energy), will be considered as organic subjects of the ecosystem to coordinate RAISE initiatives with investment 1.5 Development of the tertiary vocational training system (ITS) of PNRR Mission 4. In this sense, the ecosystem proposes to support the ITS in order to enhance the tertiary vocational training offer by making its network available (companies, universities and technological/scientific research centres, local authorities).

Finally, again with reference to the PNRR Mission 4 Component 2, great attention will be paid to initiatives to support the financing of start-ups, including through the Investor Network that will be set up as part of the SPOKE 5 actions.

In Section A, full coherence with the research and innovation policies and programming of the Liguria Region has been reported.

In this respect, the full synergy of the ecosystem (and in particular of the activities of SPOKE 1 and 2) with the clinical and research activities of the new hospital – with a strong focus on biomedical technologies and computational medicine – whose construction is planned in the city of Genova at Erzelli area. The financing system of this “hospital of the future” is linked to component 6 of the National Recovery and Resilience Plan.

I declare that I have read the information on the processing of personal data provided in the "Privacy" section <http://www.mur.gov.it/it/privacy> of the Ministry of University and Research issued according to article 13 of the Regulation 679/2016 of the European Parliament of 27th April 2016.

Date 10 June 2022

The Legal Representative of the proposer  
(*Digital signature*)