07
Implementing the LifeTime Strategic Research Agenda

The LifeTime vision is based on the successful development and integration of its three technology pillars, bringing together expertise currently scattered across Europe to support a more data-driven and patient-centred European healthcare. To propel European science and medicine into a position of global leadership, the LifeTime Strategic Research Agenda (SRA) proposes a long-term collaborative effort. It is sustained by an open and interactive European community based on cooperation among a range of disciplines and programmes. This requires a consolidated pan-European action plan, as no individual EU member state can provide the necessary resources and offer comprehensive expertise in all the technological and scientific fields implicated in delivering the impact of the SRA.

This SRA proposes an implementation plan drawing on imaginative organisation of existing infrastructure, investment in new infrastructure and opportunities for innovative collaborative research centred around connected infrastructure hubs, the multidisciplinary LifeTime Cell Centres. This framework includes a shared biomedical data management programme, a medico-scientific research and technology integration programme, programmes for training and bioethics as well as an open innovation framework accelerating the translation of knowledge into clinical use.

Europe has for many years invested in better development and use of large research infrastructures through the strategy-led approach of the European Strategy Forum on Research Infrastructures (ESFRI) Roadmap; a wide range of technologies and their further development are supported by ESFRI Projects and ESFRI Landmarks. Many of the Life Sciences European Research Infrastructure Consortium (ERICs) will be strong collaboration partners for the proposed initiative, but there is a need for an additional, more flexible approach to take LifeTime's fast-developing pioneer technologies to the user and novel applications to the clinic. The LifeTime concept rests on upgrading, extending and connecting small and medium sized infrastructures and R&D units with different specialisations, funded partly by national initiatives. Establishing a network of these infrastructures and R&D units with focus on their interoperability, complementarity and access would not only enable the progress of technology development per se, but provide cost-effective access of researchers and innovators and talent to the LifeTime technologies everywhere in Europe. It would deliver essential, cutting-edge technological support, develop and implement new technologies and train the next generation of scientists. These multidisciplinary LifeTime Cell Centres should operate in close association with hospitals and be linked by a shared data infrastructure (section 7.2), innovation strategy (section 4 and section 7.4) and education programme (section 6 and section 7.4). The founding set of interdisciplinary infrastructure nodes should complement each other's strengths and expertise in the three LifeTime technology areas and function as vantage points for a growing network. This offers the advantage of accelerating the generation of data standards for science and the clinics as well as promoting scientific excellence across Europe, without the complex set-up of a dedicated pan-European infrastructure. New centres should be allowed to join this open network, thereby fostering its agility and the capability to react quickly to technological progress and emerging challenges.

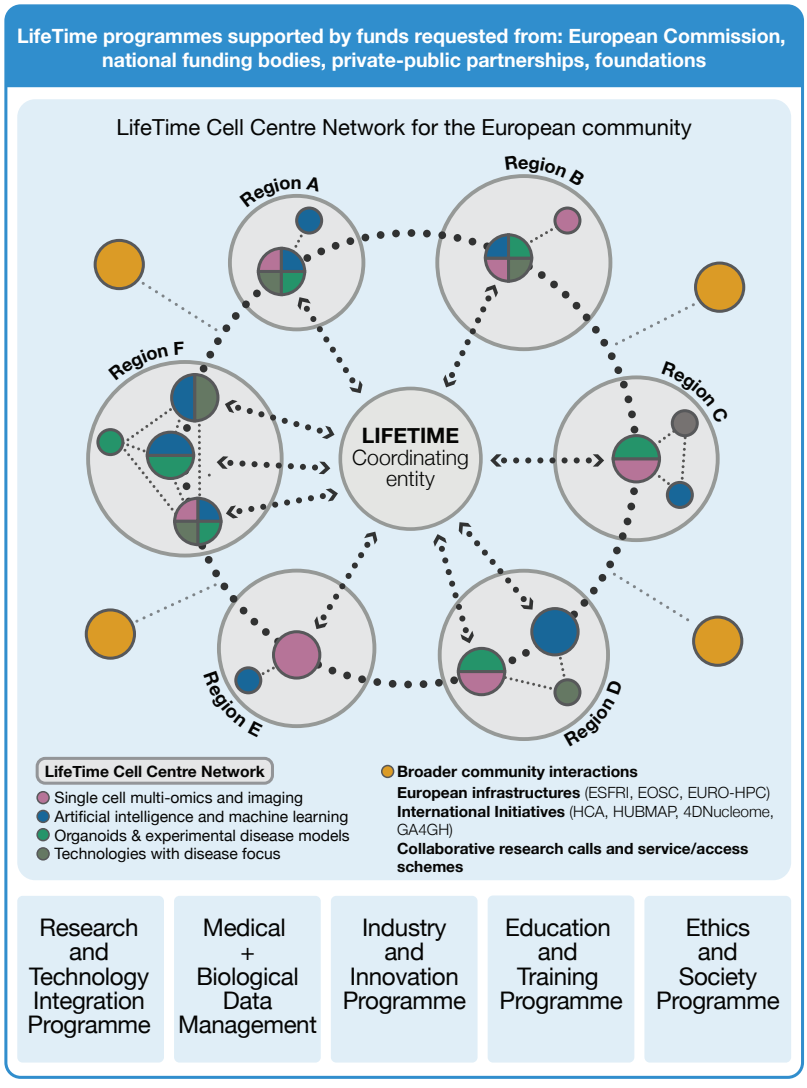
Building on but not dependent on this network, LifeTime puts forward a comprehensive research and technology integration programme encompassing the three key technology areas (section 3.1) applied to solving critical medical challenges in major therapeutic areas (section 3.2). The LifeTime Launchpad, a key mechanism employed for the identification of the medical challenges presented in this SRA will allow to continually survey upcoming technologies and clinical developments, promising great future impact for patients. LifeTime promotes an open discussion with stakeholders, foreseeing a citizen engagement programme and continual exchange with experts in bioethics, which can be a model for collaborative medical and research programmes in Europe. To safeguard successful implementation and deliver the envisioned impact, an optimal fit of these interlacing elements has to be assured. Hence we strongly recommend to create a central coordination body to optimise collaboration and increase coherence and effectiveness (section 7.3) of the LifeTime Cell Centre network and the proposed programmes.

The concept of consolidating breakthrough technologies in a synergistic manner will complement and strongly cooperate with projects of the ESFRI Roadmap and other existing national, European and international efforts, especially the Human Cell Atlas, which can be foreseen to be a strong and complementary partner.

7.1 The LifeTime Cell Centre Network

The LifeTime concept is based on the successful integration of several breakthrough technologies to achieve the envisioned major medical impact, which requires multidisciplinary action on a European level. The sum of individual efforts cannot compare with the strong potential and synergies of a coordinated approach, especially with regard to interoperability of procedures, standards, quality control or avoiding duplication of efforts. The LifeTime technology pillars are fast moving, pioneering R&D areas, their consolidation requires both a stabilising framework as well as a maximum of flexibility in order to flourish. To deliver the necessary coherence and coordination while maintaining the capability to react quickly to new challenges, LifeTime proposes to set up a network of European Cell Centres.

The Cell Centres will typically be small or medium sized infrastructures or research & technology units attached to already existing research institutions, universities or larger infrastructures (although setting up new centres is not excluded). The Cell Centres are planned to be operating synergistically but independently from each other, functioning as pivotal points for open collaboration and the advancement and integration of state-of-the-art technologies. They will share resources, gather the necessary critical mass for global competitiveness and form a powerful network stimulating the development of novel approaches in the national context and on the European stage. Close interaction between the centres is expected to expedite progress of research and technology development and facilitate common data standards and operating procedures, leading to the effective exchange, comparison and exploitation of data and research results. Additionally the network would fulfill the role of providing world class services to users both from the LifeTime research & technology integration programme and the wider community, local and (inter) national as well as to academia- and industry-based researchers and innovators. An example for this is the organoid field, which would strongly profit from new protocols, standardisation, automation and benchmarking.



LifeTime implementation Blueprint

The European Cell Centre concept requires the centres to operate in tight association with hospitals and to actively integrate technology development with clinical practice, also ensuring access to bio-samples and clinical data. To optimise interactions, the Cell Centres should be located in close proximity to a hospital and, if applicable, include a strong thematic focus on the specific diseases dealt with at the clinic. This close alliance will allow research results to be quickly turned into solutions and applied in day-to-day clinical work. The connected but geographically distributed nodes will serve as innovation hubs with strong links to industry, aiming to replace individual cooperation agreements with a joint collaboration framework for business and academia. The objective is to create an open innovation ecosystem accelerating research, technology transfer and eventually the introduction of new products and services in the market, for instance sensitive diagnostic and progression biomarkers and promising new combination therapies for major aggressive cancers.

Key functions of the LifeTime Cell Centres:

- **Serve as platforms for the development and advancement of breakthrough technologies for single-cell research, machine learning/artificial intelligence and experimental disease models**
- **Closely and actively collaborate with hospitals and clinicians, in some cases with a specific disease focus**
- **Set standards in data generation, standardisation and management supporting the FAIR principles**
- **Offer opportunities to collaborate, test and benchmark new analysis methods**
- **Offer unique opportunities to industry to translate recent knowledge and novel technologies from the laboratory to the market**
- **Provide an early technology adoption platform across Europe**
- **Function as open, interconnected education hubs, delivering training in the new technologies to researchers, scientific personnel and clinicians, as well as provide engagement activities for patients and citizens**
- **Offer opportunities for methods developers to access benchmarked datasets and to deliver new methodologies**

Training and education occupy a prime position for supporting sustainable innovation and raising scientific excellence across Europe. Easy access and widespread dissemination of the new LifeTime technologies and approaches will play a crucial role in creating open and accessible knowledge flows. The initiative's comprehensive education and training programme (section 6), will be nourished by the daily work at the LifeTime Cell Centres, which will act as education and training centres serving the whole scientific community as well as offering information and opportunities for European patients and citizens to engage.

The integrated R&D perspective of the Cell Centre network is expected to provide the necessary cohesion but also allows to accommodate different systems, funding models, as well as the different approaches to research infrastructures in a Europe-wide context. It could constitute an engine and vehicle for excellence and innovation by linking priorities and funding instruments on the institutional, regional, national and European levels. An increasing number of countries, including Italy[1], Germany[2] or Poland[3], have started to invest into programmes that closely align with the LifeTime vision. Several of these nationally funded efforts could together build the core of the Cell Centre network and specific activities be scaled up across the network. An example is the Single-Cell Accelerator Programme[4] successfully executed at the VIB in Belgium. Since the network would offer services accessible to the whole scientific community, hospitals and industry, its activities would not exclusively benefit the institutions and countries involved but provide stimulation and impetus for research, technology development and transfer across Europe and beyond. While it is foreseen that the basis of Cell Centre funding should stem from national sources, in order to maximise impact of the LifeTime SRA we explicitly stress that further pan-European investment in the network is required to reach full operability and scalability. This applies especially to the proposed bio-medical computational infrastructure. Additional funding will greatly expedite the collaborative approaches between Research Performing Organisations (RPO), universities, hospitals, business and industry, patients and society at large.

1 Human Organoid Models Integrative Center (HOMIC) - University of Milan
2 Berlin single cell research focus - Berlin single cell hospital; MDC, BIH & Charité
3 LifeTime Single Cell Center; IBCH PAS & NIEB PAS
4 VIB Single Cell Accelerator

Criteria for a LifeTime Cell Centre

Owing to their different national contexts, thematic specialisations and backgrounds, the LifeTime Cell Centres will operate following their own organisational models. A set of principles will create a conducive environment for delivering LifeTime Research and Technology Integration. It will also provide the required cohesion, set quality standards and create the optimal conditions to carry out benchmarking exercises and perform evaluations ensuring scientific excellence of the individual centres and the network as a whole. These principles will also ease effective collaboration between the Cell Centres and support long-term sustainability of the network.

A centre will have to comply with defining criteria and follow requirements concerning implementation and operation to qualify as a LifeTime Cell Centre. In order to be considered as a Cell Centre, a unit/ infrastructure needs a funding plan with a view to long-term sustainability, clearly expressed support from the (national) government/funders as well as institutional support from the superordinate entity (if applicable). It will have to follow an overall strategy with defined objectives compatible with network objectives and introduce an access policy based on the European Charter for Access to Research Infrastructures as well as a reliable and a normalised reference framework for impact assessment (key performance indicators - KPI). Its governance structure has to be in line with the network governance structure including clear responsibilities and reporting lines. It is expected to comply with network policies on user support structure, data management, audits/reviews/evaluation, and a quality management programme with inter-laboratory analyses to ensure accreditation and quality.

Cell Centre defining criteria:

- **Closely collaborate with hospitals to enable the transfer of solutions to the clinic;**
- **Integrate the three LifeTime technology pillars**
- **Build on different priorities and strengths**
- **Be complementary (particularly at the beginning of the network)**
- **Participate in the development of shared standards**
- **Educate young scientists and clinicians**
- **Establish a technology transfer programme**
- **Provide services to the community**

7.2 Medical and Biological Data Management Platform

The initiatives proposed in this SRA, and scientific and technological advancements in related fields, will create an unprecedented amount of data. The scale of data brought about by new technologies, close collaboration across Europe and beyond and novel analytics using artificial intelligence (AI) (section 3.1.2) requires upgrading of the European biodata compute infrastructure. Unlocking the potential of big data in medicine through high-quality, standardised data and predictive and interpretive AI-driven computational models will require considerable infrastructure investment on the European level. We propose a data management platform resting on federated cloud computing solutions and connected to high-performance computing centres, which will fit into and be a valuable contribution to the Digital Europe strategy. It will coordinate standardisation, ensure quality management and benchmarking and will benefit multiple stakeholders including scientists, clinicians and industry.

The LifeTime Data Infrastructure in the Context of Existing European Initiatives

The LifeTime Science and Technology Roadmap will foster new ways of using high-volume leading-edge omics and imaging technologies to address pertinent questions in human health. The scale of the data being generated, the cross-disciplinary and international structure combined with the ambition of LifeTime to pioneer novel analytics using AI, mean that an implementation of the proposed SRA will require but also shape the next generation of the European biodata compute infrastructure. As a result of this, substantial and sustained investments into computational infrastructure are essential and will benefit multiple stakeholders including scientists, clinicians and industry.

We recommend that the core data infrastructure of LifeTime should build on a federated compute and data model, borrowing and extending concepts from the existing federation model of the European Genome-Phenome Archive (EGA), which is also the preferred technology to realise the European '1+ Million Genomes' Initiative. While the first national implementations of federated EGA nodes are already underway, for example the Nordic ELIXIR Nodes (DK, FI, NO, SE) and the German Human Genome-Phenome Archive, LifeTime poses unique additional challenges and requirements that go beyond sharing of genome and omics data. These future hurdles include the deep integration of multi-omics assays, imaging and critically also health records. Consequently, LifeTime is uniquely positioned to pioneer technologies and a biodata infrastructure to enable the deep integration of data across domains, linking up currently disconnected biodata infrastructures.

Key Requirements and Needs for a LifeTime Data Infrastructure

The LifeTime vision includes the establishment of Cell Centres across Europe, which provide expertise and training in the three technological pillars, single-cell analytics, AI and machine learning and personalised experimental disease models. Connected to these data generation hubs, we envision a federated compute network, leveraging national investment, providing substantial capacity for computational processing, disk space as well as fast networks to enable federated analytics across the LifeTime Cell Centres. The following points outline the design requirements & guide capacity estimates:

- **Large-scale data centres with a compute and storage capacity that is comparable to current existing European data infrastructures (e.g. EMBL-EBI, CERN). The proposed programmes will generate sequencing and imaging data on the scale of multiple petabyte per year, and this rate is expected to accelerate rapidly as research and technology development progress**

- **Multi-tier encrypted storage systems, supplying high-performance I/O for data processing and analysis but also long-term archival, including geo redundant archival mechanisms across centres**

- **Versatile and flexible computing setup, equipped to both supply high-volume I/O-intensive data processing tasks, but also to address the computing requirements of machine learning and AI algorithms and methods. The strong integration of AI technologies in particular will require new designs that are not realised in classical biodata infrastructures**

- **Mechanisms and incentives for public-private partnerships, for example to foster pioneering technologies (e.g. faster processing, in memory computation, etc.)**

- **Upgrading and extending network data infrastructure, including fast data links between centres, thereby enabling seamless data integration and facilitating distributed analytics (to bring algorithms to data)**

- The biodata infrastructure realised as a federated network, built on cloud computing technologies, connected to and strongly integrated with the European Open Science Cloud (EOSC), owing to technical, financial but also ethico-legal constraints. Strong requirements on certification, data protection and privacy measures are required given the nature of the data.

- Strong networks of expertise and training to enable a new generation of scientists to maximally leverage novel compute and data strategies, including federated and distributed computation

- Points of contact with biobank and national clinical infrastructures and a standards approach to support federated clinical data discovery, access, harmonisation and analysis

7.3 Community Coordination and Governance

The LifeTime SRA puts forward a multi-layered research and innovation programme whose complementary and comprehensive approach promises to be flexible and capable of rapid responses as well as providing a stable framework encouraging the setting of standards for the sharing of medical data across Europe and beyond. A crucial challenge is the effective and efficient coordination across all proposed efforts to deliver on evolving and transforming disease detection and treatment and facilitate the transition to a more data-driven and patient-centred European healthcare. We need to integrate the key technologies: single-cell technologies and imaging, AI and machine learning, and personalised disease models. We need to build the required data infrastructure capable of supporting the sharing of biomedical data and standardisation of data and operating protocols. We need to explore and identify answers to essential medical questions, their translation into new solutions and clinical applications including transfer to the market; and we need to educate and train a new generation of researchers and clinicians and engage with patients and society as a whole. This bold vision relies on both an underlying infrastructure network providing the necessary conditions for excellent technology development as well a flexible programme of research and innovation projects, which act independently but are also jointly coordinated and steered for maximal impact. For this purpose, and to help avoid parallel and fragmented efforts, we propose to establish a central coordinating body across all LifeTime activities, which requires dedicated European cohesion funding with mid to long-term sustainability. This potentially virtual central hub would ensure coherence of the implemented activities and should list the coordination of the Cell Centre network, the LifeTime Education and Training Programme, the Ethics Mechanism and Launchpad Mechanism among its principal tasks. Further functions should include overseeing the continual Launchpad mechanism as well as a review board to evaluate the contribution of independently funded projects towards realising LifeTime's full impact (section 2).

The governance model of a LifeTime central hub should be built on dedicated governing bodies, with an assembly of all members having full decision making power. Individual institutes should formally join the LifeTime network, the assembly representatives being designated by the member organisations. An executive board with an executive director and team to handle the day-to-day management of the initiative should be nominated. A variety of working groups and committees handling different aspects would provide the necessary input and support the assembly in its decision making. Such groups will include a medico-scientific board with separate committees for the technology pillars and disease areas, data management, training, ethics and public engagement. We would like to particularly mention the Launchpad Mechanism, which should follow the procedures adopted to identify the medical challenges for this SRA to scout for novel technologies and monitor new disease challenges. Each key industry sector should be represented in a strategic advisory innovation board, which should provide input to the SRA in general and particularly the Industry and Innovation Programme. The governance scheme has to determine clear responsibilities and reporting lines, as well as international supervisory and relevant external advisory bodies.

7.4 Research and Technology Integration and Training

The multi-level approach put forward in this SRA comprises, along with the Cell Centre concept, programmes in research and technology integration, education and training as well as ethics and society. These separate elements act synergistically, are mutually beneficial and strongly benefit from a cross-pollination of ideas but are not strictly dependent on each other for implementation, even if quality and impact would be substantially curtailed through a patchwork policy. Whilst it is possible to focus on selected elements of the global SRA and achieve partial success, only substantial adoption of the agenda promises major output.

We believe that a dedicated large-scale initiative would provide the best conditions to achieve the envisioned impact but we are committed to exploring alternative routes. The proposed programmes require an imaginative and creative use of existing funding instruments, as well as new investment to deliver novel solutions for Europe. Projects should preferentially involve but not exclusively require the LifeTime Cell Centres. We propose funding through a portfolio of research opportunities, stemming from projects both on the national as well as European level. Existing project funds from European programmes could be bundled to feature topics relevant to LifeTime research or projects belonging to Pillar II of Horizon Europe, such as projects in the framework of the Mission on Cancer or the European Commission (EC) Roadmap on Europe's Beating Cancer Plan. Even ERC single investigator and synergy grants could if thematically within the framework of LifeTime contribute towards the goals of this Strategic Research Agenda. Funding of LifeTime's education and training programmes could benefit from available European resources such as the Innovative Training Networks, the European Joint Doctorates or COFUND initiatives for PhD candidates and post-docs, the Erasmus Mundus Joint Masters Degrees for master's students, or the Research and Innovation Staff Exchange initiative. The Pathfinder and Accelerator programme of the European Innovation Council (EIC) as well as projects associated to the European Innovation Ecosystem as part of Pillar III could add important contributions for collaboration with industry. We propose to set up a pre-seed pre-incubation fund for innovation projects, in particular for technology bundling, and proof of concept calls could be earmarked for LifeTime. IMI/EU Health PPP calls or calls from thematically related partnerships will also offer opportunities for LifeTime projects. National as well as private funding will provide additional opportunities.

This heterogeneous landscape of funding sources with projects being reviewed independently of the LifeTime SRA and according to their own programme logic may make it challenging in some cases to assess the potential contribution of a funded project to the overall LifeTime strategy and to align the different projects. Initiatives that have received funding and have registered interest to be part of the LifeTime canon, should be reviewed by a dedicated board of the coordinating body (section 7.3) to determine if they are in line with LifeTime's objectives, standards and operating procedures. Potential criteria include: relevance to the LifeTime objectives, contribution to the envisioned LifeTime impact (section 2), strategy concerning data sharing, standards and quality control. It is conceivable to introduce a tier system including LifeTime core and associate projects.

It is expected that the programme will interact with, benefit and take inspiration from existing key European programmes such as the biological and medical research infrastructures from the ESFRI Roadmap, the Digital Europe strategy through the European Open Science Cloud or the European High- Performance Computing Joint Undertaking. A special relationship with projects related to the Human Cell Atlas is foreseen, especially with regard to metadata analysis, data sharing, standards and quality control, as already started with the joint task force on COVID-19.

7.5 Ethics and Society Programme

The proposed LifeTime Ethics Mechanism (section 5.1) will continually monitor the ethical implications raised by the fast development of technology and the resulting new way of delivering medicine. "Ethics parallel research" will ensure that scientific developments, research choices and their clinical application will be used for the benefit of the patient. We recommend that all research projects and programmes put forward by this SRA should make sure that linked ethical considerations are practically considered and implemented in the research. A dedicated project, such as a "Science with and for Society"-type project, would be important to develop such a mechanism and explore the wider implications.

The possibility to make early and detailed diagnoses will trigger positive reactions in the sense of prevention and empower patients to better manage their own health. However, it will also ask for a more proactive role of patients and raise a number of concerns relating to trust in science and questions of self-perception, which will impact acceptance of interceptive medicine. We propose a shared decision-making process through engaging citizens in LifeTime's governance and an activating citizen programme.

The LifeTime initiative is strongly committed to clear, effective and knowledge-based external and internal communications. The programmes proposed in this SRA will encourage participation and contribution from political, public and commercial audiences across Europe and world-wide. The communication strategy will aim to place LifeTime at the cutting-edge of communication and engagement practices, including incorporating the Open Science principles, and will actively seek to ensure that the knowledge it generates is freely accessible to the wider scientific community and also both open and comprehensible to the public. In recognition of the breadth of relevant audiences and their differing requirements, LifeTime's engagement approach will be tailored specifically to best meet these needs, performing assessments of each audience type's requirements, the aim of the communications, and the most effective methods of achieving this objective.

7.6 A dedicated Innovation Framework to Implement the LifeTime Industry Strategy

The development and integration of the three technology pillars will require close collaboration between the public and private sectors spanning multiple disciplines. Programmes fostering existing and establishing new links between both sectors will accelerate the translation of discoveries into solutions, contributing to the health of European citizens. In the absence of a long-term and well-defined legal basis provided by a EU subsidy programme such as the Framework Partnership Agreement used for the H2020 FET-Flagship projects or the regulations of the Innovative Medicines Initiative 2 Joint Undertaking, it is complex to create a general framework for innovative ways of interacting and sharing risk between stakeholders, supporting public/private partnerships and business creation and requires a long-term vision.

Several ongoing EU, national or institutional activities in different European countries could help kick-start the innovation activities and serve as blueprints to build LifeTime industry engagement platforms (see sections 4.1 - 4.5). There are several successful local initiatives fostering new technology adoption and co-development which could be scaled-up and/or coordinated across Europe. In Belgium the VIB has been very active in this area with the tech watch programme and the technology innovation lab and most relevant the innovative VIB single-cell Accelerator rolled out in 2017. Dedicated competitive grants for early technology adoption could not only benefit industry technology providers but also the exploitation of new technology developed by academics and support creation of start-ups in Europe. An adapted legal framework established between academic and industry partners ensuring the protection of inventions and their use for commercial applications could be a way to incentivise technology providers other than pharma companies to develop a European precision medicine sector. Another important step would be to engage regulators and regulatory bodies earlier, in particular to enable early disease interception.

The development of an open innovation ecosystem could be in part aided by a dedicated networking/brokerage platform, which could take the form of partnering with existing academia/industry event platforms, for instance, collaborating with the ERICs ELIXIR and Euro-BioImaging to co-organise SME events and cover topics around imaging, data analysis and data management. For single-cell technology providers, forming new networks to support community building should be explored by using existing models, e.g. COST actions. Platforms such as the recently launched Open Discovery Innovation Network (ODIN) programme at Aarhus University or the OpenTargets platform, an innovative public-private partnership between pharma and public data providers using human genetics and genomics data for systematic drug target identification, provide an alternative model. A network of the Technology Transfer Offices (TTOs) of institutes engaged in the LifeTime SRA and a shared programme fostering further intersectoral mobility could be developed with template agreements.

In order to facilitate the creation of start-up companies, we propose to establish a dedicated early stage investment fund. Building on EU programmes and networks such as the EIC and the EIT Health, as well as institutional initiatives (e.g. EMBL Ventures), the fund management should have strong early-stage investment experience and offer not only flexible financial support but also expertise, resources, time adapted to each innovation project in order to create lasting value. Funding for a pre-seed, pre-incubation scheme based on competitive calls could be provided by institutional and private investors (VC, business angels, private equity and also corporate investments from industry partners) in Europe.

The EC could also support this effort to foster technology bundling with for instance FET proactive calls earmarked for LifeTime technology integration topics.

7.7 European and International Context and Collaboration

The proposed SRA supports a number of key EU strategies. A new cell-based, data-driven medicine based on breakthrough single-cell/imaging and organoid technologies will require the accelerated uptake of AI and continual upgrading of High Performance Computing (HPC), which are both central points of the Digital Europe strategy. The highly complex challenge of implementing precision medicine concepts requires the free flow of information including electronic health records and genomic information for research, linking it closely to the European Open Science Cloud (EOSC) and European Data programmes such as the 1+Million Genomes Initiative. Pooling, integrating and sharing of high-quality, interoperable data are crucial for a European Health Data space, necessitating questions of standards, definitions and data annotation to be solved at the European level. The proposed research and development concepts will influence personalised interceptive medicine and directly contribute but not be restricted to Europe's Beating Cancer Plan and be closely linked to the Horizon Europe Mission on Cancer. As set out in this SRA, the proposed technological concepts are applicable to a number of other disease areas and will add important approaches to the European One Health Action Plan against Antimicrobial Resistance. Most importantly, they will contribute to a joint European response to the current COVID-19 pandemic and add to the world-wide effort of rapidly identifying mechanisms, new drug targets and ways of containing infections before they can take hold across the globe.

While the Cell Centres are expected to be operating embedded in the national context, performing together as the LifeTime Cell Centre network will add further functions, create synergies and facilitate collaboration. Open access for the European scientific community will constitute a key element to drive European research in the three LifeTime technology pillars and allow to gather the critical mass instrumental for a European lead in these areas.

Cooperation with the European Life Sciences Research Infrastructures

The LifeTime Cell Centre network and the proposed research and technology integration programme will result in opportunities to closely interact with established European research infrastructures, especially in the fields of bioinformatics and data – ELIXIR, in the area of biobanks - BBMRI-ERIC, for imaging - Euro-BioImaging, and the medical research facilities EATRIS-ERIC and ECRIN-ERIC but also other relevant Life Sciences ERICs. As a basis for collaboration, regular meetings to exchange information about activities in the different areas and to identify opportunities to converge have been put on the agenda. LifeTime and the Life Sciences Research Infrastructures (LSRI) agree that a possible outcome could be to identify suitable funding opportunities that could help establish such a collaboration. Furthermore we see opportunities to align efforts to ensure that LifeTime centres can interface with the emerging European Open Science Cloud (EOSC).

Link to the Human Cell Atlas

The Human Cell Atlas (HCA) and LifeTime share the objective to chart human biology in unprecedented detail by leveraging the recent explosion of single-cell and spatial analysis technologies. Despite many key synergies, the goals of the two initiatives are not congruent. The HCA's objective is to create comprehensive reference maps of all human cells as a basis for both understanding human health and diagnosing, monitoring, and treating disease. In contrast, while sharing many approaches with the HCA, the LifeTime SRA puts forward a comprehensive framework for implementing data-driven medicine in Europe within the next decade. It is based on research and technology development programmes integrating three key technologies to address priority medical challenges, including an innovation framework and the LifeTime Education and Training Programme. Close links between LifeTime and the HCA are expected to be mutually beneficial, establishing a common framework for openly sharing knowledge, tools, data, and other resources. An example is the joint COVID-19 registry, where members of both initiatives and others can contribute their expertise and the scientific and technological power of single-cell analysis and data integration to unravel the interaction of SARS-CoV-2 with the cells and tissues of the human body.

Working with Other Initiatives

The programmes and actions proposed in this SRA will link to other existing efforts, for instance international alliances such as IHEC, or European partnerships such as the IMI/EU Health PPP and help to streamline interaction between national European and international programmes. Internationally, LifeTime will build on multiple research and innovation programmes for single-cell data generation and technology development, such as the NIH common fund programmes in the US e.g. the Human BioMolecular Atlas Programme (HuBMAP). LifeTime will use best practice guidelines from existing large-scale consortium projects, including the Human Genome Project, the Cancer Genome Atlas, the ICGC, the NCI's Genomic Data Commons, and the GA4GH. The LifeTime Cell Centres will work together with EU supercomputing facilities (Partnership for Advanced Computing in Europe (PRACE), Jülich Supercomputing Centre, DE; BSC, ES; CINECA & INFN, IT; ICHB PAN-PCSS, PL) and national distributed grids of university high performance computing centres. A number of potential disease specific interaction partners initiatives can be found in section 3.2.