HELMHOLTZ

Research for grand challenges.

Considerations on Research Infrastructures in FP10 and their relation to Technology Infrastructures

The high-level task force on RI of the Helmholtz Association has developed this contribution as input for the upcoming EU Framework Programme for Research and Innovation 2028-2034.

The commitment of Helmholtz to European collaboration in research is underpinned by the operation of world-leading large-scale research infrastructures (RI). These facilities range from X-ray, neutron- and ion-sources, to supercomputers, field observatories, research vessels, aircrafts and satellites. In addition, Helmholtz is involved in several European distributed research infrastructures. Our RI are open to national and international academic users free of charge. Access is excellence-based, determined through peer-reviewed proposals. In addition, our RI constitute a central hub for training of the next generation of researchers, engineers and data stewards. To keep pace with the advancements in science, our centres regularly assess the need for the construction of new RI.

The newest Helmholtz Roadmap for RI, which is the subject of continuous revisions, is accessible at https://go.fzj.de/Dj2mC.

At Helmholtz, we believe that a specific programme part for RI with adequate and stable funding within FP10 (with its dedicated configuration of the programme committee), as well as an efficient coordination is needed for Europe. It is a prerequisite to cope with the increasing competition from the US and Asia, to attract international talent to Europe, to strengthen efficient research collaborations rooted in the use of RI at the technological cutting edge and to fully exploit the innovation potential of RI across all research areas.

A dedicated RI programme within FP10:

- Accounts for at least 5% of the total budget of the framework programme. The growing number of European RI challenging the coordination of their collaboration, the evolution of their service portfolio, including remote operation, data management compliant with FAIR principles and the promotion of an Open Science culture need substantial EU funding. This is the only way, true European added-value going beyond national interest can be generated, and a seamless integration of RI in a European RI ecosystem, accessible to all researchers wherever they are based, can be realised.
- Will allow to implement concepts for sustainable trans-national access (TNA), exploring new approaches and possibilities for mixed funding, e.g. involving structural funds or co-financed by Member States (MS) that do not operate own RI through research-field agnostic and long-perspective funding instruments. Funding programmes for TNA should encourage lean and efficient management structures. Challenge-driven TNA should not conflict with scientific excellence and a responsible use of travel funding and must elicit the training of future RI operators and users.
- Strengthens the collaboration of RI in Europe and ensures their world-leadership through roadmap-based approaches, ideally supported by long-perspective funding instruments (e.g. framework partnership agreements/FPA), for
  - i) enhanced coordination and continuous adaptation of services to changing user demands, including cloud services integration
  - ii) collaboration on technological developments to keep pace with the latest advancements of science

iii) fostering innovation potential for RI and creating the framework conditions enabling the full exploitation of this potential while keeping the right balance between innovation and basic research.

- Develops new concepts for Green RI, as their climate footprint demands creative and collaborative solutions.

National RI with a strong European relevance, as evidenced by the number of their users from other EU Member States must be considered equivalent to ESFRIs and ERICs, provided that access is granted on the basis of excellence, and their visibility should be increased in further programme parts in FP10. Discrimination due to legal forms must be avoided in FP10, since this affects the choice of the most appropriate form by a consortium. Opting for an ERIC has to be one option out of several.

Technology Infrastructures

Several Helmholtz centres are exploring the role of their facilities and expertise in view of a tighter collaboration with industry, which aligns well with the concept of technology infrastructures (TI). At Helmholtz, we believe that a clear strategy to optimise investments from Member States, European regions and EU programmes and providing directionality is needed for TIs. Initiatives that need to be streamlined and bundled in a specific chapter (area of intervention or destination) on technology infrastructures and with a dedicated budget, include (among others), European Digital Innovation Hubs, Technology Experimentation Platforms, EDICs and OITBs.

Further components of such a future programme part for TI should include a tailored support for industry by training development and quality-assurance engineers or by supporting mediator companies in the ecosystem that design, prepare, perform and interpret measurements for industry or public authorities. TI still need to upscale support to industry by e.g. increasing volume of samples or reducing its analysis time using AI. Standardisation of (e.g. measuring) methods at TI also need support under a future programme for TI.

Highlights along the Helmholtz Research Fields

We would also like to emphasise that in further developing the TI policy, it is vital to involve those RI that also provide services to industry. This is the case for many of the Helmholtz facilities. To illustrate this further, we have gathered a few highlights along Helmholtz Research Fields:

Helmholtz Energy offers companies unique platforms for developing innovations and reach market maturity, e.g. in the fields of renewable energies and sector coupling. Power-to-X infrastructures with varying focus enable the validation of technologies, such as the conversion of hydrogen and CO_2 into synthetic fuels under semi-industrial conditions. By combining real systems with simulation in the Smart Energy System Simulation and Control Center of the Energy Lab, companies can also test and optimize their technologies for smart energy grids.

To ensure the long-term economic viability of solar thermal power plants, constructors and operators of power plants use measurement and testing methods to assess the performance parameters and ageing resistance of components and systems: At the QUARZ® Center, researchers are developing qualification methods for components and systems for solar thermal power plants and applying them in their own test benches. The measurements are in accordance with published standards and norms to ensure the state of the art and comparability. Producers from all over the world use the qualification of their components by QUARZ. The innovation platform SolarTAP creates new structures and opportunities for technology transfer and the joint use of large-scale equipment, specialised infrastructures and data for multi-benefit photovoltaic applications, which are developed and tested together with industry partners.

Helmholtz Earth and Environment offers novel data services and products from combining harmonized observations from its distributed observational networks with information from a wide range of other sources. These and other services are accessible to a broad community of users from local to continental scales. In addition, Helmholtz Earth and Environment makes its technological infrastructures, such as analytical laboratories and sensor technology, as well as research data from satellite missions, research stations, -vessels and -aircraft, or application-orientated innovation laboratories available to science and industry, including SMEs. In co-operations, in the field of contract research, in services or through rental agreements, the equipment is used either on site or in the field to address economically relevant challenges.

Examples include environmental monitoring, plant phenotyping, natural hazard warning systems, climate adaptation solution labs, drilling technology sensors and agricultural or geothermal applications. Three Helmholtz Innovation Labs facilitate the joint use of RI with partners from industry and authorities, NGOs and social stakeholders to solve application-related problems in the field of e.g. biotechnological processes, remote sensing and underground seismics.

Helmholtz Innovation Platforms promote the co-development of reliable, affordable and user-friendly ocean observing technologies, standards and best practices together with industry and civil society specifically designed for interoperability on non-scientific infrastructure. To improve the accessibility and usability of our research data, Helmholtz Earth and Environment introduced the DataHub initiative. The DataHub aims to provide decentralized data tools and platforms for integrating research data into processes and portals, from data collection to archiving. Through the DataHub we support the national research data infrastructure initiative NFDI and the European Open Science Cloud.

Helmholtz Health relies on and grants external partners' access to infrastructures addressing such crucial technologies as imaging (from molecules to humans), specialized OMICS (including single cell and spatial technologies), computational analytics, disease models, BSL3 laboratories and screening facilities. Key infrastructures include large-scale robotic biorepositories, bioengineering platforms, imaging technology innovations and GMP facilities. Large cohorts provide the biomaterial and data for, among other fields, prevention and early disease detection, and for studying ageing and multimorbidity. Clinical research infrastructures, jointly operated by Helmholtz Centers and University medical centers, accelerate the translation of breakthrough research findings into early clinical trials. Big data infrastructures for storage, retrieval and analytics are the foundation of many current and future approaches to health-related data-based research.

Helmholtz Information offers consulting and project support for high-performance computing, artificial intelligence and quantum computing to industrial users at all competence levels. It also provides industrial users with computing time on Europe's fastest high-performance and AI supercomputers as well as on quantum computers within JUNIQ, the Jülich UNified Infrastructure for Quantum Computing. The digital infrastructure EBRAINS provides science and industry with access to high-quality neuroscience data and tools for analysis, modeling, and simulation.

Training programs in neuro- and data science, AI and computational modeling accelerate industrial R&D in drug discovery, medical devices, and neurotechnology. The startup SpiNNcloud Systems commercializing an energy-efficient AI platform with the SpiNNaker2 system is a successful collaboration between science and industry born of EBRAINS.

Helmholtz Information also provides companies with platforms for materials design and innovation for energy storage and conversion materials, for information technologies with materials for quantum information, novel memory and processor technologies, and for the medical and pharmaceutical sectors. This approach has been successfully employed with the integration of the self-driving lab network Auto.MAP into one of the world's largest consortia for autonomous AI/ML-supported research for the digitalization of health technologies and energy materials, the "Helmholtz Acceleration Alliance".

Helmholtz Matter offers their large analytical infrastructures to food safety agencies to analyse toxic levels of Cadmium in Cocoa beans or help packaging companies in testing food contact materials. In the area of MedTech, our engineers work together with SMEs in building prototypes for whole-body real-time magnetic resonance imaging or support the pharma industry in their drug design to map precise and rapid molecular interactions.

The Helmholtz Innovation platform Hi-Acts provides comprehensive support for industry research and development projects by offering and further developing rapid access to innovative accelerator technologies via one single entry point e.g. in securing supply of radionuclides for the MedTech ecosystem.

In the field of microelectronics, our innovators test spintronic approaches for their use in tiny magnetic structures to store data or perform logic operations with very low power consumption, offer high-energy implantation of ions in silicon or test defects in SiC used as single photon emitters for quantum sensing.

Regarding material sciences, our analytical facilities provide tools to investigate advanced functional materials concerning their chemical and structural properties at the atomic scale. Helmholtz Matter also studies the atomic structure of film membranes to understand permeability processes in polymers and the cyclability-induced porosity in batteries. Helmholtz Matter operates selected facilities as TIs, providing fast, tailored analysis services in collaboration with the industrial users.

About Helmholtz:

We are Germany's largest research organization. At Helmholtz, more than 46 000 people work together in 18 centres and develop solutions and technologies for the world of tomorrow. With an annual budget of six billion euros and long-term, interdisciplinary research programs and unique research infrastructures, we address global challenges - in our six thematic fields: Energy, Earth & Environment, Health, Information, Matter and Aeronautics, Space & Transport.

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