Research Infrastructure Programme of the University of Helsinki

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1 Summary

The research infrastructures of the University of Helsinki are developed with a systematic and long-term approach. Their operations play a key role in implementing the University's strategic plan and directing research activities. Research infrastructures are linked to national and international research fields, and their shared use opens up opportunities for research renewal and collaboration with the University's partners and society.

The University has internal processes for committing to major national and international research infrastructures. These processes are used to ensure that the University and the host units of the infrastructures at the level of faculties and independent institutes are aware of the resources needed for maintaining and developing infrastructures, and that the host units are committed to covering the related operating costs. At the University level, development efforts and commitments are reviewed by the research infrastructure committee, which is headed by the vice-rector for research. Research infrastructure working groups on the University's campuses are responsible for assessing and prioritising infrastructures, and assist units in preparing development guidelines if needed.

Ensuring the preconditions for research infrastructures requires the considered allocation of resources to research infrastructure components, staff, facilities and support services. With regard to both the technical and academic staff involved with infrastructures, the University pays attention to career opportunities and their improvement. Skilled staff involved in operating research infrastructures is a crucial resource to ensure optimal use of research infrastructures. Key elements of infrastructure support services include financial and staff support and data services associated with infrastructures, and services that improve their visibility and accessibility.

Focus areas of research infrastructure development at the University of Helsinki

- **Maintenance of the competitiveness of research infrastructures in terms of both local and broader national and international entities**
- **Systematic choices and prioritisation in accordance with the University's strategic plan, procurement coordination**
- **Management of produced datasets, data infrastructure for research**
- **Openness of research infrastructures and the findability of related descriptive information**
- **Ensuring shared use**
- **Recruitment of skilled operating staff and maintenance of human resources, competitive career paths for staff**

2 Introduction

The University of Helsinki is Finland's largest and leading multidisciplinary research university, and it enjoys a strong position in European and global research arenas. Research infrastructures and their continuous development are key to the University's further development. Research excellence requires first-rate infrastructures. State-of-the-art research infrastructures and a considered policy towards their further development also provide better opportunities for recruiting internationally recognised researchers in various disciplines.

The University of Helsinki's Research Infrastructure Programme outlines the principles for the development of research infrastructures. The programme supports decision-making by describing

the processes and definitions of development, selection and resource allocation, also making it easier to communicate on these principles to the University's partners. Similar to other guidelines of the University's operations, the research infrastructure programme is reviewed and updated at regular intervals, taking into consideration changes in the operating environment. Regarding the principles of the openness and accessibility of research infrastructures, the University of Helsinki adheres to, among other things, the policies of the League of European Research Universities (LERU) and the EU as well as national and international principles of open science.

3 Development of research infrastructures

Research infrastructure is a general concept that denotes a pool of research instruments, equipment, material and services, which increases the impact and international attractiveness of the research, education and innovation system. Research infrastructure services enable the conduct of research and development, support researcher education and teaching as well as maintain and develop research and innovation capacity. For a more detailed definition, see Appendix 1 to this programme.

The multidisciplinary nature of the University of Helsinki also characterises its research infrastructures. Of the University's over 2,100 principal investigators and research groups, most use University research infrastructures on a daily basis. Alongside traditional infrastructures focused on tools and equipment, there are virtual and distributed infrastructures in all fields of science. The University's research is highly networked both nationally and internationally, and all campuses feature infrastructures at both these levels. The University of Helsinki is the most important developer and administrator of research infrastructures in Finland, as well as a very active operator in the field on the European scale.

The short- and long-term processing and preservation of research data will be increasingly important for research infrastructures. The University of Helsinki follows technical developments actively, establishes new practices and procedures, and contributes to the national and international development of research data infrastructures.

3.1 Infrastructures as part of the University's strategy and its implementation

Substantial amount of funding and other resources are annually allocated to research infrastructures at the University of Helsinki. Operations are also funded from other sources, both national and international. To derive the greatest possible benefit from such funding, a coordinated policy and clear development guidelines are needed. This work requires contributions by units, faculties and independent institutes involved in research, on the campuses and at the University level.

Research infrastructures and their development play a key role in the strategic plan of the University of Helsinki (2021–2030) and the related planning of measures. Research infrastructures are linked to the following goals of the strategic plan:

- 1. A multidisciplinary scientific partner of international standing
- 2. Research-based knowledge in support of societal decision-making
- 3. High-quality, up-to-date research infrastructures
- 4. Open science – openly available research infrastructures and materials
- 5. Competence in the analysis and management of open datasets
- 6. Facilities fit for their purpose
- 7. A strong connection between teaching and research
- 10. Science education
- 16. Business collaboration and innovation
- 19. An attractive employer
- 21. Sustainability

In the strategic plan, infrastructures are not only highlighted directly through the measures targeted at them, but also indirectly as enablers of entities related to research and teaching, such as the roadmap for implementing research themes. For detailed descriptions of these measures, see the University's strategic plan and its implementation plan.

Strategic planning and responsibilities at different levels

Over the course of their life cycle, research infrastructures are interlinked with University operations at various organisational levels. The development of research infrastructures requires active collaboration between infrastructures, their host units (faculties, independent institutes), campuses, thematic operators that transcend unit boundaries and the University level. Their interplay has been outlined in the diagram below, which presents the levels of operations and the relevant operators at these levels, as well as the documents directing the operating environment. In the diagram, 'campus level' denotes collaboration between units conducted on campuses as well as thematic collaboration between campuses.

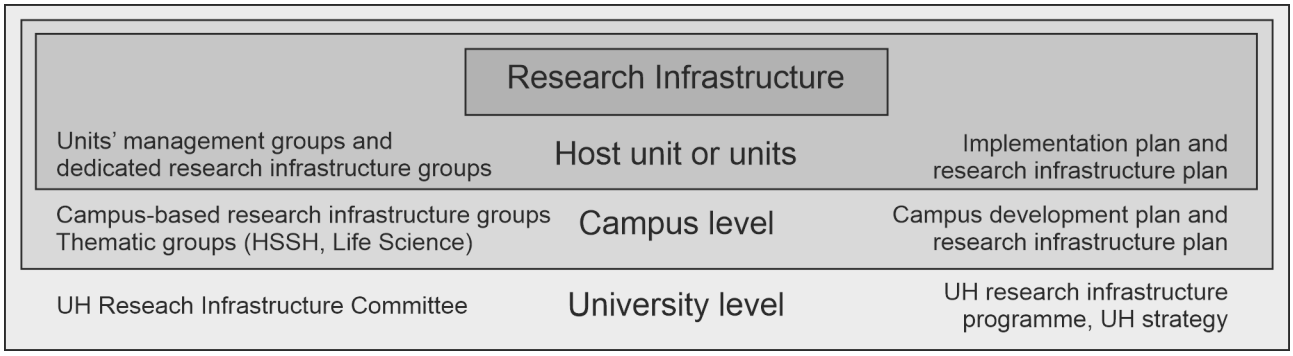

Figure 1. Levels, operators and documents directing operations related to research infrastructures.

University leadership and University Services

The University's leadership is responsible for drawing up a research infrastructure policy and monitoring its implementation at the University level. The leadership is supported by University Services and the University's research infrastructure committee, which utilise the information available from campuses and cooperate closely with campus-based working groups and researchers. University Services plays an important role in ensuring inter-campus cooperation through research infrastructure working groups and in the University-level prioritisation of projects. In addition, University Services promotes the spread of good practices established on the campuses into University-wide operating models and also establishes communication practices that apply to the University as a whole. University Services assists research infrastructures in drawing up and concluding agreements, pricing their operations and organising cooperation opportunities.

In accordance with the strategic plan of the University, key research infrastructures and technology services are defined, and the University participates in national and international projects within this framework. The purpose is to ensure top-level and high-profile research that is developed further in the long term. The systematic classification of resources supports the distribution of information about research infrastructures and their use both within the University and to partners and stakeholders as well as promotes the harmonisation of practices between various research infrastructures.

Campuses, independent institutes and faculties

On the campuses, the primary responsibility for the development, procurement and upkeep of research infrastructures lies with the relevant faculties and independent institutes, referred to in this context as 'host units'. They must take University-level guidelines into account in selecting projects and classifying infrastructures. In the case of large-scale procurements in particular, collaboration between units should be organised and agreed also in terms of upkeep and funding. Written

contracts on the responsibilities are a good way to monitor the continuous costs associated with research infrastructures and determine the division of responsibilities between the host units.

As part of operational development, faculties and independent institutes draw up their own research infrastructure plans, defining in detail development goals, principles and responsibilities. If necessary, the plans can also be drawn up by sub-units (e.g., faculty departments). In drawing up the plans, cooperation is encouraged with the faculties and independent institutes located on the relevant campuses as well as with stakeholders and other organisations (e.g., public research institutes, other higher education institutions and educational institutions, the Hospital District of Helsinki and Uusimaa and other healthcare operators).

The plans should include information about the matters in the list below, which is roughly organised by theme (strategic plan, resources, collaboration and openness). The plans do not have to adhere strictly to the structure below.

- Research profile from the perspective of research infrastructures
- The means necessary for enabling new research initiatives
- The duties and responsibilities of the working groups that manage research infrastructures
- Description of unit-specific procurement processes
- Equipment procurement and related depreciations as a tool for planning operations
- HR matters
- Existing commitments to infrastructures and related allocated resources
- Collaboration among faculties, independent institutes and campuses
- Openness of infrastructures and criteria for use
- Uniform classification criteria
- Providing information on research infrastructures and keeping it up to date

In the development of research infrastructures, it is important to take into consideration the structure surrounding them, including the research stations and various research laboratories of host units. The development of research infrastructures and their life-cycle management requires the management of the overall operations of the units involved.

Campus-specific research infrastructure plans are based on the plans of faculties and independent institutes, with particular emphasis on cooperation between units and the broader development of thematic entities. Key operators in drawing up the campus-specific plans include the campus-based research infrastructure working groups, which monitor the plans of faculties and independent institutes on their campus or within a specific thematic area. To facilitate campus-level planning, units exchange information on their annual planning calendars and the process for drawing up the plans through the research infrastructure working groups.

Research infrastructures must be developed systematically on a long-term basis, and overlapping investments should be eliminated. The long-term approach should also be reflected in life-cycle thinking, which requires consideration of all stages of research infrastructure use, from planning to phasing out. Before undertaking a major project, the needs of other University campuses as well as opportunities for shared use must be considered. The leaders of campus working groups must keep in contact with each other to explore possible synergies when prioritising projects for University-level funding application rounds.

In addition to the campus- and unit-based structure, research infrastructures are developed in thematic networks and entities, such as the Helsinki Institute of Life Science (HiLIFE), the Helsinki Institute for Social Sciences and Humanities (HSSH) and the Institute for Atmospheric and Earth System Research (INAR). In the development of research infrastructures as a whole, close collaboration between thematic and organisational units and working groups is of utmost importance.

Research infrastructures and operations management

As part of strategic planning, faculties and independent institutes draw up their own implementation plans, which describe the link between the development of unit-specific research infrastructures and the University's strategic plan. The direction of unit-specific profile building and other strategic development guidelines play a key role in the targeting of investments and the development of research infrastructures.

It must be noted that international research infrastructures in particular are mostly major undertakings that require long-term investment. Funding and other resources allocated to research infrastructures need to be sufficient for procurement and the maintenance of the infrastructures in terms of both staff and equipment. The importance of host organisations as owners of infrastructures and administrators of operations has been further emphasised in recent years. Thus, implementation plans should take support services into account both at the establishment stage and subsequently over several years.

3.2 Procedures for the development of research infrastructures

Research infrastructures as thematic entities

To get the most out of research infrastructures, their development is considered from a number of perspectives at the University. Research infrastructures can be both discipline-specific and multidisciplinary, thematically integrative entities. In their development, consideration is given to other strategic development of the University and the structural development of the University and the research field. The operating environment of research infrastructures and their development are affected by, among other things, the University's profile-building activities, Academy of Finland Flagships and other strategic national projects, and the implementation of the roadmap for research in accordance with the University's strategic plan. Extensive thematic entities require comprehensive analysis of the operating environment when designing and assessing research infrastructures.

Working groups focused on research infrastructures

The vice-rector for research, supported by the University's research infrastructure committee, is in charge of the development of the University's research infrastructures. The committee is composed of members or chairs of the research infrastructure working groups of all of the University's campuses. The composition of the research infrastructure committee is confirmed by a rector's decision.

At the campus level, the development of research infrastructures is steered by research infrastructure working groups, which may include representatives from both faculties and campus-based independent institutes. Faculties and independent institutes may also establish separate bodies. It is also possible to combine campus-based working groups into thematic entities, such as the joint life science working group (LS-RIC) of Meilahti and Viikki Campuses. Research infrastructures in the humanities and social sciences are examined collaboratively by the vice-deans for research of the faculties at the City Centre Campus and the research infrastructure working group of HSSH.

Selections and related processes

The optimal use of resources and the transparent selection of projects constitute the basic principles of committing to and investing in research infrastructures. To eliminate unnecessary duplicate purchases, the available resources are allocated via an assessment procedure. The projects to be supported are selected at the University level by the research infrastructure committee and at the campus and host unit levels by the relevant working groups and committees, including thematic working groups. The LS-RIC group coordinates the development of research infrastructures in the life sciences and is responsible, among other things, for assessing infrastructure projects in the life sciences as part of University-wide processes.

Ensuring the flow of information between different research infrastructure working groups is key to optimising choices and coordination efforts. Members of the University's research infrastructure committee contribute to the work of their home campuses and thematic groups, much like representatives of campus-based groups are involved in the planning efforts of host units.

In terms of commitment and selecting the infrastructure projects to be funded, consideration is given to, for example, the scholarly level of the projects, their applicability to the University's and the host unit's research profile, and the urgency of their investment needs. Of particular importance is that the host unit(s) (faculty or independent institute) of the research infrastructure commit to maintaining operations and covering the infrastructure costs in the long term.

A commitment by the University requires that the activities of the research infrastructure also serve user groups outside the host unit. To promote the successful selection of projects and expedite the process, campus-based working groups and committees compile a report, updated annually, on research infrastructures, their status and development needs as well as the focus areas for investment.

The University's commitment to research infrastructure projects

The University commits to major research infrastructure projects in a centralised manner. Typically, such projects are infrastructures of significant national or international importance, to which the University commits as an organisation, even if the actual operations are distributed into a single unit or a handful of units (faculty, independent institute) at the University. Examples of such commitment include the infrastructures included in the national roadmap for research infrastructures, projects seeking FIRI funding from the Academy of Finland and participation in research infrastructures where Finland is a member state.

The projects are selected on the basis of criteria specified in the previous section. To the extent possible, the University's commitment is ensured through shared processes regardless of discipline (Figure 2). In the case of internal processes related to national assessment, the process is harmonised with a national-level procedure, and the need for separate internal efforts is minimised.

If it is difficult to assign an infrastructure project to a specific campus (due to the multidisciplinary nature of the project or the location of the host unit on several campuses), the proposal can be submitted to several campus working groups for consideration.

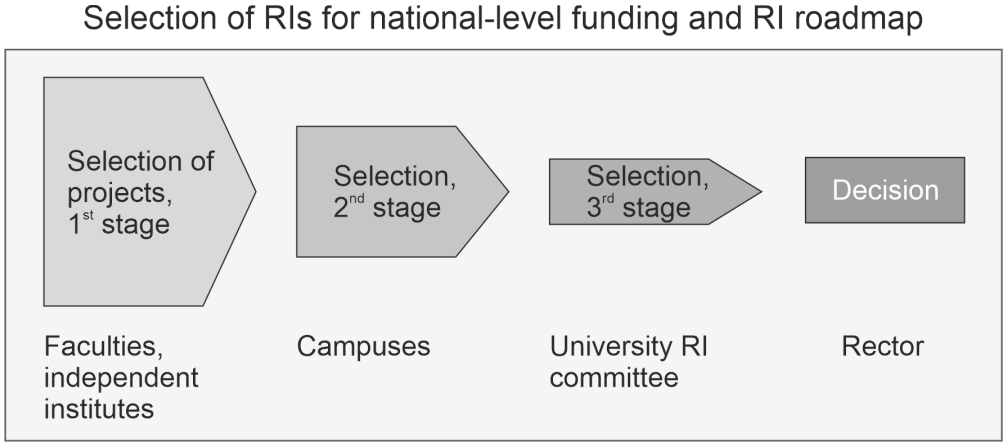

Figure 2. The process of selecting extensive research infrastructure projects at the University that require its commitment. The height of the arrows depicts the number of projects proceeding to the following stage. The thematic broad-based working groups (the life science group and the SSH group) are also involved in the processing at the campus stage.

Due to the various stages involved, special attention needs to be paid to the timetables of the application processes. Where necessary, information about timetables should also be provided to

external project partners. Funders' schedules give limited consideration to the internal processes of organisations and the related scheduling needs.

Support for the development of research infrastructures

In the development of infrastructures, Research Services and Financial Services are the most important operators under University Services. The former coordinates activities at the University level, supports the University's research infrastructure committee and communicates with campus-based working groups. Research Services also cooperates actively with Financial Services on the funding of research infrastructures. The Laboratory Services unit under Research Services organises equipment maintenance at the University and coordinates the functioning of laboratory staff pools and permits related to laboratory operations in accordance with its operational description. Financial Services assists the directors of individual research infrastructures as well as the leadership of faculties and independent institutes in planning project finances and the overall investments of units.

Special questions related to the development of large-scale research infrastructures

When planning to join a large national or international research infrastructure, preparations are needed not only for scientific activities, but also with regard to administration of the infrastructure and commitment at the University and national levels. Research Services provides assistance in administrative and legal matters, and in communication with operators at the national level (government ministries, Academy of Finland).

Statements and other expressions of support by the University concerning the various stages of national and international preparations are prepared by Research Services, in cooperation with the relevant research infrastructure. The processes related to these preparations are applied on a case-by-case basis, and their scope relates to the planned status of, among others, Finland and the University of Helsinki as part of the whole. The extremes are represented here by i) research infrastructures headquartered in Finland and nationally coordinated by the University of Helsinki and ii) research infrastructures where Finland is a member and whose national operations are coordinated by parties other than the University of Helsinki.

3.3 Co-development

The University of Helsinki strives to promote the shared use and co-development of research infrastructures across organisational boundaries. The goal is for the University and its partners to have similar guidelines for the principles of the use and development of research infrastructures.

When necessary, partnerships are established at the organisational level, and campus- or research infrastructure -specific collaboration agreements are concluded for the purposes of collaborative development. In accordance with the University's internal policies, the aim is to target the resources used for research infrastructures as optimally as possible, while avoiding unnecessary overlaps.

University units and stakeholders on the campuses should regularly and actively discuss the development of research infrastructures as part of joint campus operations. Moreover, campus-specific research infrastructure development plans should also take into consideration the University's partners. Depending on the circumstances and research infrastructure, co-development partners can include academic operators and other educational institutions, government research institutes and other public operations, as well as businesses. The innovation and entrepreneurship services unit jointly coordinated by Research Services and Communications and Community Relations assists research infrastructures in matters related to the organisation of business collaboration. Key support in terms of collaboration agreements is provided by the Legal Services and Support for Research Management units under Research Services.

4 Financial sustainability and other sustainability issues

The various aspects of sustainability are important criteria for the development of the University of Helsinki's research infrastructures. As a rule, research infrastructures constitute very long-term investments, in which their life-cycle management is emphasised from planning to implementation, use (and in-service updating), and their eventual phasing out.

Sustainable planning takes into account the fact that the resources required by research infrastructures vary at different stages of their life cycle. In terms of resource management, it is particularly important to ensure that the host units of research infrastructures (faculties, independent institutes) have sufficient and up-to-date information on the projects. In the University's financial structure, resources for the development of research infrastructures come from host units. Without the support of host units, the University will not commit to research infrastructures as an organisation. Infrastructure-intensive units in particular must take into consideration their costs when determining future goals as part of overall operational and financial planning. In addition to the unit's core funding, various funding opportunities should be comprehensively explored in the planning process. When funding research infrastructures, faculties, departments and independent institutes must also take into account depreciations related to purchases. Sufficient resources must be provided in the funding plans to cover the costs of investments for the entire depreciation period.

When deciding on commitment, host units must assess the needs of the research infrastructure and the units' own resources (staff, finances, facilities). For example, basing the finances largely on external funding may pose a risk to the maintenance of the research infrastructure, if this has not been anticipated at the planning and commitment stage. When allocating the resources available, consideration is given to the potential of joint procurement and services, both between faculties and with partners.

Research infrastructures cannot function or develop without skilled staff. It is important for infrastructures and their host units to maintain an up-to-date overview of staff and strive for long-term human resources planning. At the University level, career paths for the academic and technical staff of research infrastructures will be developed during the strategy period to enable the University to retain and recruit the best experts.

In addition to staff and specific equipment included in or planned for research infrastructures, facility needs should be investigated as early as possible in the research infrastructure life cycle. If the research infrastructure requires investments in special facilities, this will be taken into consideration in the planning of the unit's facilities. The guidelines of the University's facilities programme also apply to research infrastructure facilities.

Continuing the support for research infrastructures in operation and related preconditions

Support for research infrastructures and its continuation is considered as a part of life-cycle management. It is natural for research infrastructures to evolve and renew over time and, when necessary, even systematically to be phased out. At the University of Helsinki, consideration is given to the following:

- Significance of the research infrastructure to the relevant field and the University's strategic plan (from host units to the University level)
- Sufficient breadth of the researcher community (University users, other use) so that the resource allocation for the research infrastructure is feasible
- Resource allocation in host units, including the scope of the funding base for the research infrastructure

- Discussions with partner organisations
- National significance, national or international commitments

National and international research infrastructures in particular produce a substantial amount of reports on their operations for funders and for the internal monitoring of their operations. The University will establish a process for better and increasingly systematic utilisation of these materials for internal reviews.

The actual phasing out of a research infrastructure requires that the infrastructure has not been of operational or scientific significance to the University and the unit(s) responsible for its maintenance for several years. Especially if the research infrastructure to be phased out is connected to more extensive national or international operations, the phasing out is carried out in cooperation with the other partners. The collaboration agreements of national and international research infrastructures typically lay out the procedures enabling individual parties to withdraw from the operations.

4.1 Financial support at the University

University level, faculties and independent institutes

In the University's funding model, support for research infrastructures is channelled through their host units (faculties and independent institutes). There is no separate centralised funding allocation for these operations. The funding model is a factor in making the commitment of host units to research infrastructures critical, also including cases where the University as an organisation is formally committed to maintaining the infrastructure.

The budgets of research infrastructure–intensive units must take into consideration the resources required for maintenance and development. In the case of infrastructures with several host units, fair distribution of financial liabilities between the units must be ensured and agreed on as part of operational planning. Even if investments can be made with the help of external funding, their self-financing shares, a common requirement, constitute a significant expenditure, particularly in equipment-heavy research infrastructures.

External funding (both national and international) is a significant means for making major investments in research equipment and other extensive development of research infrastructures. To minimise the risks associated with the funding of operations, the University encourages research infrastructures to seek a broad-based funding base. By examining the funding base, the University avoids situations where long-term commitments are made to infrastructures solely through a single source of competitive funding (e.g., Academy of Finland FIRI funding).

Other mechanisms for covering operating costs

Using non-research funding to cover part of the operating costs of research infrastructures is highly recommended. This can entail a range of research collaboration, commissioned research, consultation or sponsorship, co-development, or research and other collaboration in larger research consortia. On a case-by-case basis, grants for the development of research infrastructures can also be obtained from foundations or through other endowments. Funding the utilisation of infrastructures partially with user fees is a natural part of infrastructure operations, and it does not constitute an obstacle to the University's principle of the openness of research infrastructures. The use of research infrastructures is priced according to the University's valid pricing guidelines.

In the case of market-priced commissioned research or consultation, the commissioning party defines the goals of research together with the University and receives ownership or other specifically determined rights to the research results. Since the University is not permitted to allocate public funds to supporting businesses, businesses cannot obtain exclusive rights to the results of research carried out collaboratively or even partially with public funds. In the case of such research, the results are published and utilised in accordance with the funding terms and the principles of the University.

Other examples of various contractual forms of business collaboration include collaborative research where the University obtains data from the business collaboration partner; collaborative research where the costs are covered by the business and the University, resulting in the co-ownership of the results; and sponsorship associated with conferences, goods or services. Also carried out with businesses are various collaboration projects based on co-development for which practices are agreed together, teaching collaboration and thesis collaboration related to different stages of studies. Through co-development it may also be possible to procure components of research infrastructures as demo devices or otherwise below the market price.

In the case of fee-based non-academic services, the preconditions of publicly funded activities must always be taken into consideration, and such services cannot be the primary purpose of use if the research infrastructure has been procured with public funds. Restrictions can also apply if components of the research infrastructure have been procured for academic use under restricted licenses or procurement terms. In publicly funded projects, the terms and conditions set by the funder (e.g., EU funding instruments, Academy of Finland, Business Finland) are observed. In terms of service purchases and sales, each project must be examined separately. In some projects, the funder accepts, for example, rental and equipment costs, while in others they do not. Equipment procured by some projects can be used for service provision, but some funders prohibit this.

4.2 Sustainability and responsibility of operations

One of the focus areas of the University of Helsinki's strategic plan is leadership in sustainability and responsibility. The guidelines of the University of Helsinki's sustainability and responsibility plan will also be taken into consideration in the development of research infrastructures. On a broader scale, the University's sustainability guidelines are based on, among other things, the Sustainable Development Goals of the United Nations and, at the national level, the guidelines of Universities Finland (UNIFI).

In the operations of research infrastructures, these questions manifest, for example, as responsible and optimised procurement as well as the maintenance of the openness of use and the accessibility of infrastructures throughout their life cycle. In terms of the operational preconditions of research infrastructures, sustainability perspectives also encompass, on a case-by-case basis, the planning of the use of infrastructure facilities, the optimisation of the energy sources used and other measures that minimise the carbon footprint of operations. Achieving carbon neutrality by 2030 is a goal for the University's current strategy period.

5 Openness and accessibility

5.1 Open science – Open infrastructures – Open data

Openness and terms of use

The University of Helsinki develops its research infrastructures in accordance with the principles of open science. The University's research infrastructures constitute a whole in which the fundamental principles of accessibility promote shared use, while also taking into consideration differences in accessibility between individual infrastructures.

Openness and accessibility are key elements in determining the University's research infrastructures (Appendix 1). This does not mean free-of-charge use or subjective access rights. It is possible to charge a fee for the use of infrastructures, and infrastructures can choose their users based on well-grounded reasons. However, extensive accessibility means that the use of infrastructures should not be unduly restricted. In the first half of the strategy period, a University-wide process for analysing the use and utilisation rate of infrastructures will be established, with the focus on employing currently available information systems. The goal is to establish a systematic procedure that takes into account the special characteristics of various disciplines and research infrastructure types.

At the European level, the principles of the openness of research infrastructures have been laid down by, for example, the League of European Research Universities (LERU) and the European Commission. The University of Helsinki complies with these guidelines in its operations.

- LERU principles of Open Access to RIs
- EU Charter for access to RIs

Findability, access to descriptive information

The most important central source of information describing the research infrastructures of the University of Helsinki is the infrastructure portal under the Research Portal database (https://researchportal.helsinki.fi/en/equipments/), which lists essential information on the University's research infrastructures on different campuses. University Services and Helsinki University Library oversee the administration of the portal framework. Host units and, ultimately, those maintaining research infrastructures are responsible for submitting the information featured in the portal. This will ensure that the portal always contains the latest information and valid contact details. Interfaces between different systems are utilised in submitting information, in which case they are kept up to date in one location (Research Portal). Automated transfer of data from the University's infrastructure portal to the national research data repository under construction will be organised for infrastructures selected for this purpose.

Information about individual pieces of research equipment is stored in the University's equipment register. The equipment register makes it possible to access information related to equipment relevant to the functioning and shared use of research infrastructures directly from the Research Portal, and to link the information to the research infrastructures described in the portal. In such cases, maintaining information on research infrastructure components in the Research Portal will be easier, as they need to be kept up to date in the equipment register only.

Describing infrastructure services

The websites of research infrastructures' host units should include descriptions of research infrastructures and the services offered both within the University and to external partners. If a research infrastructure is used for commercial purposes, service descriptions and contact details must be available on the infrastructure website and in the Research Portal. To make the best possible use of research infrastructures, it is important to design their description in a way that supports multidisciplinary activities and various user groups (e.g., academic collaboration, different forms of business collaboration, citizen science).

5.2 Data management

Infrastructures and the University's research data policy

The guidelines of the University of Helsinki's research data policy also apply to the University's research infrastructures. The University's research data policy was updated at the end of 2021 and is available, in addition to the University's internal channels, in the Helda repository (link above) and on the University's public website: https://www.helsinki.fi/en/research/research-integrity/open-science. The guidelines emphasise increasing the openness of science and research, a goal that is implemented carefully in a secure manner and whose achievement enables the commercial utilisation of research findings. The University's research data policy takes into consideration national and international regulations and recommendations on the processing of research data throughout their life cycle. In addition to the University's internal policies, national and international research infrastructures may have their own jointly agreed policies for the processing of the data that they produce.

Research infrastructures oriented on extensive service provision in particular should draw up a data management policy, which describes the principles for the processing, storing, sharing, distributing and preserving of data generated by the infrastructure, as well as for its disposal. A clear data

management policy helps to structure the operating practices of the infrastructure and resolve any potential conflicts related to its operations, in addition to which it facilitates the application for external funding. University Services and the library's data support provide research infrastructures with assistance in drawing up their data management policies, including templates and general advice.

Perspectives related to data management in research infrastructures:

- Division of responsibilities in data management and data ownership
    - University/host organisation, research infrastructure and users as key parties
- Local, national and international cooperation, role of the various organisations in storing data
    - CSC, national or international discipline-specific data warehouses/repositories
    - Avoiding the establishment of overlapping data infrastructures and ensuring the accessibility of data
- Long-term storage of data generated by the research infrastructure and related processes

6 Research infrastructures and teaching

6.1 Using research infrastructures in doctoral education and other teaching

In the strategic plan of the University of Helsinki, engaging students in research and the work of research groups from an early stage of studies constitutes a central principle for strengthening the connection between research and teaching. Research infrastructures are a necessary part of research, which makes it natural that they also play a significant role in doctoral education and teaching.

When designing and developing research infrastructures, their availability for teaching, when deemed necessary, must be ensured. Particularly in fields utilising measuring equipment and laboratories, teaching in the first years primarily takes place in teaching laboratories designed for these purposes. However, in advanced studies it is of utmost importance that students have the opportunity to become proficient in the use of actual research equipment and infrastructures as part of research groups. Research infrastructures must be prepared for this as part of their operations.

Research infrastructures can be utilised in teaching outside degree education in continuing education and continuous learning. The University's research infrastructures have the potential to provide training in adopting the use of state-of-the-art equipment as well as measuring and analysing techniques. This applies equally to virtual, data-centred research infrastructures and data analysis carried through them.

Through their operations, research infrastructures have a strong connection to teaching the practices of open science. Structured data management policies and clear processes for data handling serve as an important link in integrating the University's research data policy and other guidelines (e.g., detailed national and international discipline-specific practices, general principles of open science) into everyday research activities already during studies. Similarly, during access it is straightforward to train the users to give appropriate recognition to the research infrastructures when publishing their research. It has been recognised nationally and internationally that research infrastructures do not currently receive sufficient visibility or merit for their operations. This concerns both infrastructures as service providers and the staff maintaining them. The practices of openness and qualification processes can be effectively disseminated through modules of continuing education and other continuous learning for both researchers and partners.

Appendix 1. Research infrastructures at the University of Helsinki

Basic definition

Research infrastructures are instruments, equipment, information networks, databases, materials and services that serve to facilitate research, promote research collaboration and reinforce research and innovation capacity and know-how (Academy of Finland, 2021).

Large-scale research infrastructures are often collaboratively used across national boundaries, offering collaboration opportunities to both domestic and international researchers and other operators. On the basis of location, research infrastructures can be classified as follows:

A **single-sited** research infrastructure is fit for purpose in fields requiring major investments in expensive research equipment. Typical examples include the European Organisation for Nuclear Research (CERN) and the European Synchrotron Radiation Facility (ESRF). A single-sited infrastructure may include satellite units, and it may also permit remote use.

A **distributed** research infrastructure is suited to fields in which the available resources are geographically dispersed. A distributed infrastructure may also produce shared central services. Examples at the University of Helsinki include the Integrated Carbon Observation System (ICOS) and the Common Language Resources and Technology Infrastructure (CLARIN).

Virtual research infrastructures, or e-infrastructures, include databases and archives that users can access from their own workstations. At the University of Helsinki, such infrastructures include the Finnish National Electronic Library (FinELib) and the Finnish Biodiversity Information Facility (FinBIF).

Typical components of research infrastructures include the following:

- Research equipment, research and measuring stations, research vessels, specialist laboratories
- Research material collections and databases, archives and libraries, other memory organisations
- Telecommunications networks used in research, centres for high-performance computing and other computing capacity
- Services related to the use of research infrastructures

At the University of Helsinki, frameworks of components that offer services not only to their research group, but also to a wider range of users, are considered research infrastructures. A further condition for qualifying as a research infrastructure is that long-term plans have been made for maintenance. Consequently, a service, equipment or material used by a single laboratory or research group does not qualify as a research infrastructure, as wider connections within the University or with external partners are required.

Classifying infrastructures by the scope of operations

The research infrastructures of the University of Helsinki can be examined roughly on three levels, depending on the scope and the international nature of their operations (Figure 3). The levels are the internal level of the University, the national level and the international level.

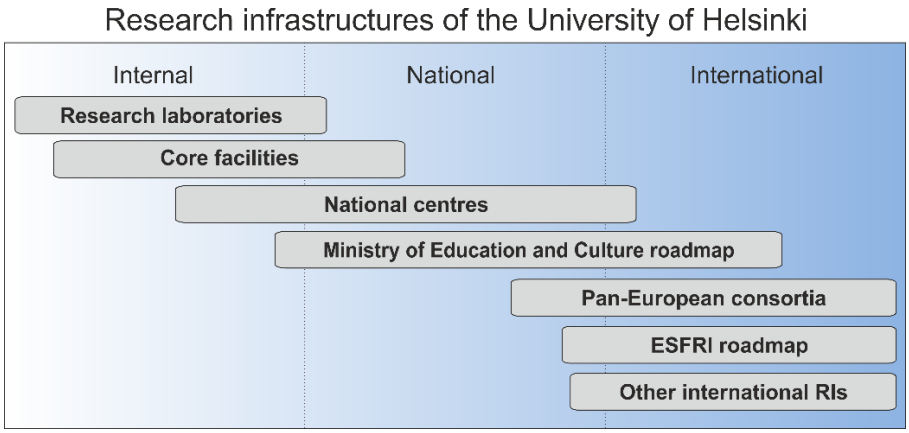

Figure 3. Placement of University of Helsinki research infrastructures at the internal, national and international levels. The horizontal width of each bar is indicative only.

Internal level at the University of Helsinki

The University of Helsinki boasts a large number of internal research infrastructures. Some of the research infrastructures at the University of Helsinki are classified according to the scope of their operations either as core facilities (including libraries) or as research laboratories in line with the criteria below. Core facilities produce high-quality research services not only for research conducted in units, but also for wider internal use as well as for external partners. It must be noted that as a rule, the research conducted at core facilities is subject to a fee. Consequently, service descriptions and price lists must be up to date and easily accessible. Research infrastructures are designated as core facilities by the research infrastructure committee.

Core facility

- Possibility to offer services on a large scale to partners outside the unit
- The service concepts and prices are clearly defined
- Paid services to outside partners are possible and routinely offered
- The core facility's goal may be (partial) self-sufficiency through paid services
- Support services of various levels are available to users (conducting measurements; collecting, analysing and storing material).
- Maintenance encompasses both human and technical resources, including a long-term development plan

National level

The Ministry of Education and Culture and the Academy of Finland maintain a roadmap for the most significant research infrastructures at the national level, which was updated in 2021 (see https://www.aka.fi/en/about-us/decision-making-bodies/firi-committee/). The University of Helsinki is contributing to the operations of 12 infrastructures included in the roadmap. The number of national-level research infrastructures at the University of Helsinki is the highest among Finnish universities, partly reflecting the multidisciplinary nature of the University of Helsinki as well as the scope and quality of its research activities.

It must be pointed out, however, that there are important research infrastructures of the University outside the roadmap which also play a distinct national role. The development of these infrastructures along with those included in the roadmaps is an integral part of the activities of the University of Helsinki.

International level

European research infrastructure spearhead projects have been collected in roadmaps published by the European Strategy Forum for Research Infrastructures (ESFRI). The University of Helsinki is one of the most active European universities participating in ESFRI projects. The University is contributing to 19 projects included in the ESFRI Roadmap. These projects cover a wide spectrum of ventures from single-sited to virtual infrastructures. A large proportion of international research infrastructures in the natural sciences are single-sited major research laboratories or centres.

International research infrastructures in general require massive investments, especially at the initial stages. No single university, including the University of Helsinki, has the required resources. Consequently, most projects are undertaken as consortia of several universities or research institutes.

Participation in ESFRI projects and other major international infrastructures such as CERN constitutes an important part of University of Helsinki's strategic plan. International research infrastructures are European and global spearhead projects that enable state-of-the art research and maintain and enhance the University's high-level research profile. Their national and international visibility greatly boosts the recruitment of talented researchers to the University.

Research infrastructures as part of broader infrastructure concepts (scientific infrastructures, knowledge infrastructures)

Research infrastructures are structures that enable research and an important link in the production and sharing of research-based knowledge. In this context, research infrastructures can be perceived as part of scientific infrastructures and, more broadly, of knowledge infrastructures. The guidelines for the development of research infrastructures takes into consideration these interconnections, ensuring that research infrastructures promote the production, combination and dissemination of research-based knowledge as broadly as possible.