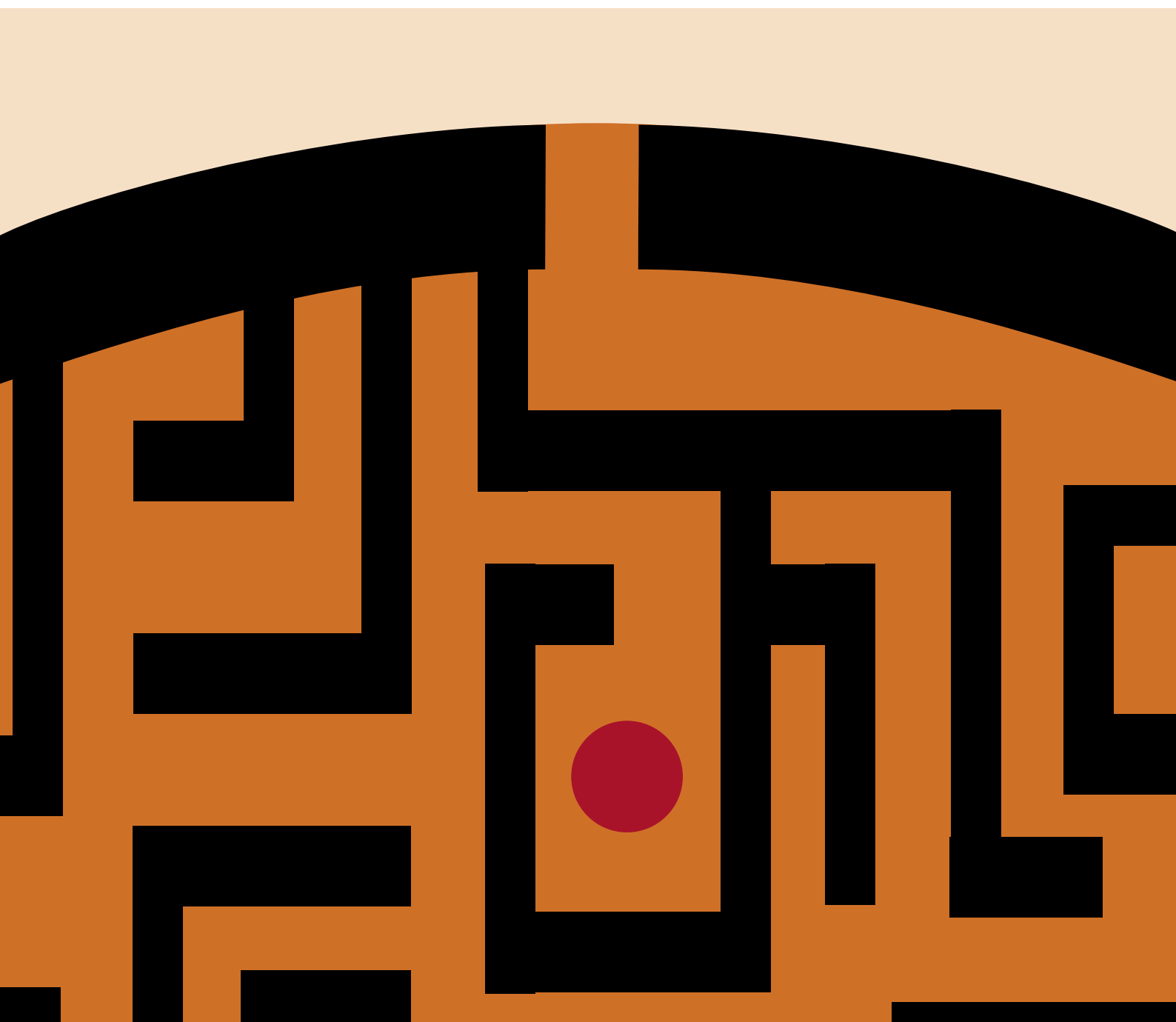


FINLAND'S STRATEGY AND ROADMAP FOR RESEARCH INFRASTRUCTURES 2014–2020



FINLAND'S STRATEGY AND ROADMAP FOR RESEARCH INFRASTRUCTURES 2014–2020

THE FINNISH RESEARCH INFRASTRUCTURE COMMITTEE



Ministry of
Education
and Culture

The Finnish Research Infrastructure Committee

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The Committee approved the strategy and roadmap on 17 December 2013.

For a list of Committee members in 2012–2014, see Appendix 1.

FOREWORD

Research infrastructures refer to research facilities, equipment, materials and services that enable research and development at various stages of innovation, while supporting organised research, research training and teaching, and developing research and innovation capacity. A state-of-the-art research infrastructure ecosystem is a prerequisite for achieving world-class research and high-quality research training, engaging in international cooperation and internationalising Finland's research community. Finland will also need leading-edge infrastructures, as well as research collaboration between research institutes and universities, in order to renew the country's industrial base and innovation activities and enable the provision of services by state research institutes.

In its Research and Innovation Policy Guidelines for 2011–2015, the Research and Innovation Council of Finland recognised that a long-term national research infrastructure policy is required to be able to develop the structures underlying Finland's research and innovation system. The policy guidelines also proposed the establishment of a permanent research infrastructure body with the task of developing Finland's national research infrastructure policy, networking Finland with international research infrastructures and administering funding allocated to research infrastructures.

In April 2012, the Academy of Finland accordingly established an expert body for research infrastructures, the Finnish Research Infrastructure Committee (FIRI Committee), under a mandate issued by the Ministry of Education, Science and Culture. The FIRI Committee comprises a broad range of representatives of Finland's public research and innovation system, universities, polytechnics, state research institutes, the Ministry of Education, Science and Culture, the Ministry of Social Affairs and Health, the Ministry of Employment and Economy, Tekes – the Finnish Funding Agency for Innovation and the Academy of Finland.

The FIRI Committee's tasks have included drawing up a Finnish research infrastructure strategy, updating the 2009 research infrastructure roadmap and administering annual research infrastructure funding. It has also outlined the overall ecosystem of national and international research infrastructures. The purpose of these activities and funding is to boost cooperation between national and international actors, to step up the joint use of infrastructures and to activate joint investments.

This document, Finland's Strategy and Roadmap for Research Infrastructures 2014–2020, includes Finland's first-ever research infrastructure strategy and an updated roadmap for 2014–2020. The research infrastructure ecosystem will be governed by this strategy. Such an ecosystem includes major national research infrastructures, Finnish actors' partnerships within European infrastructure projects (ESFRI), memberships of other international infrastructures and research organisations' strategically significant infrastructures.

According to the vision put forward by the strategy, by 2020 Finland will have gained recognition for its internationally competitive science and high-quality research infrastructures, which will also enable the renewal of teaching, society and the business sector. To realise this vision, the following measures will be required:

1. Long-term development of all research infrastructures
2. Improvements to the access to and collaborative use of research infrastructures
3. Shoring up of the funding base of research infrastructures
4. Provision of a firm basis, by the roadmap, for the methodical development of research infrastructures
5. Evaluation of the significance and impact of research infrastructures

The Strategy and Roadmap for Research Infrastructures is a plan covering the national research infrastructures to be developed and that will require renewal over the next 10–15 years. The 2014–2020 roadmap includes 31 national research infrastructures, 18 of which are ESFRI partnerships. The selection criteria include the project's importance to the Finnish scientific community and to the research strategies of the host organisations, the breadth of the user community, the need for funding and the long-term commitment of the host institutions. When making funding decisions related to research infrastructures, the Academy of Finland will take into account the development needs of the infrastructures selected for the 2014–2020 roadmap.

The FIRI Committee believes that the Strategy and Roadmap for Research Infrastructures and its recommendations will prove useful to universities and research institutes in their development of research quality within their research environments, while strengthening the impact of research and promoting internationalisation. In addition, the Committee hopes that the overview of the development phase of the research infrastructure ecosystem will support the work of ministries, as well as innovation within the private sector.

The roadmap for research infrastructures will be updated every five years.

Helsinki, 28 February 2014



Marja Makarow
Chair of the Finnish Research Infrastructure Committee
Vice President for Research
Academy of Finland

FINLAND'S RESEARCH INFRASTRUCTURES

Table 1. A: National research infrastructures on the 2014–2020 roadmap. B: Partnerships in ESFRI projects. C: International research infrastructures in which Finland has joined through (state) agreements. D: research organisations' own, local infrastructures: number by research discipline. E: Research infrastructure abbreviations in alphabetical order. F: Research infrastructure name in full.

	ROADMAP 2014–2020	B. Partnerships of Finnish actors in European infrastructure projects (ESFRI)	C. International research infrastructures which Finland has joined through state or other agreements	D. Local infrastructures denoted as significant by their host research organisations (no)
	A. National research infrastructures			
Social Sciences and Humanities	ESS Finland	ESS		
	FIN-CLARIN	CLARIN		
	FinELib			
	Finna			
	FMAS			
	FSD and CESSDA	CESSDA		
	TTA, KDK			
In total (no)	7	3	0	65
Environmental Sciences	EISCAT_3D Finland	EISCAT_3D	EISCAT	
	EPOS Finland	EPOS		
	FINMARI	EMBRC, Euro Argo		
	ICOS Finland	ICOS		
	INAR RI	ANAE		
		LIFEWATCH*		
	oGIIR **			
Energy			GBIF	
			ICDP	
			IODP	
In total (no)	6	7	4	71
Energy			ITER	
			EFDA-JET	
		JHR	JHR MTR	
In total (no)	0	1	3	7
Biological and Medical Sciences	BBMRI Finland	BBMRI		
	Biocenter Finland			
	EATRIS Finland	EATRIS		
	ELIXIR Finland	ELIXIR		
	EuBI Finland	EuBI		
	EU-OPENSOURCE Finland	EU-OPENSOURCE		
	INFRAFRONTIER Finland	INFRAFRONTIER		
	INSTRUCT Finland	INSTRUCT		
	NaPPI			
	NVVL			
		ECRIN*		
			EMBL	
Material Sciences and Analytics			INCF	
In total (no)	10	8	2	87
Material Sciences and Analytics	MAX IV			
	OtaNano			
	XFEL and XBI	XFEL		
		ESFR upgrade***	ESRF	
In total (no)	3	2	1	28
Natural Sciences and Technology	BIOECONOMY			
	CTA	CTA		
	Euclid Finland		ESA	
	JYFL-ACCLAB			
			CERN	
		E-ELT***	ESO	
		FAIR***	FAIR	
E-Science and Mathematics			NOT	
In total (no)	4	3	5	79
E-Science and Mathematics	CSC RI			
	PRACE Finland	PRACE		
	FGCI **			
			IML	
			NeIC	
In total (no)	3	1	2	7
Others			IIASA	

* National centre of research infrastructure was not selected for the roadmap 2014–2020.

** Potential project

*** Finland is a member through international research infrastructure

E. Research infrastructures, abbreviation	F. Research Infrastructure name in full
ANAE	Infrastructure for Analysis and Experimentation on Ecosystems
BBMRI	Biobanking and Biomolecular Resources Research Infrastructure
BBMRI.fi	Biobanking and Biomolecular Resources Research Infrastructure (Finland)
BIOECONOMY	Alliance for Excellence in Sustainable Biomass Refining
Biocenter Finland	Distributed National Research Infrastructure of Finnish Biocenters
CERN	European Organization for Nuclear Research
CESSDA	Consortium of European Social Science Data Archives
FSD and CESSDA	The Finnish Social Science Data Archive and Consortium of European Social Science Data Archives
CLARIN	Common Language Resources and Technology Infrastructure
CLARIN Finland (FIN-CLARIN)	Common Language Resources and Technology Infrastructure (Finland)
CSC RI	IT Centre for Science – National Infrastructure
CTA	Cherenkov Telescope Array
CTA Finland	Cherenkov Telescope Array (Finland)
EATRIS	European Advanced Translational Research Infrastructure in Medicine
EATRIS Finland	European Advanced Translational Research Infrastructure in Medicine (Finland)
ECRIN	European Clinical Research Infrastructure Network
E-ELT	European Extremely Large Telescope
EISCAT	European Incoherent Scatter Association
EISCAT_3D Finland	EISCAT_3D (Finland), ISR (incoherent scatter radar) system
ELIXIR	European Life Science Infrastructure for Biological Information
ELIXIR Finland	European Life Science Infrastructure for Biological Information
EMBL	European Molecular Biology Laboratory
EPOS	European Plate Observing System
FIN-EPOS	European Plate Observing System (Finland)
ESA	European Space Agency
ESO	European Southern Observatory
ESO Finland (FINCA)	Finnish Centre for Astronomy with ESO
ESRF	European Synchrotron Radiation Facility
ESFR upgrade	European Synchrotron Radiation Facility upgrade programme
ESS	European Social Survey
ESS Finland	European Social Survey (Finland)
EuBI	Euro-Bioluminescence
EuBI Finland	Euro-Bioluminescence (Finland)
Euclid	Euclid Cosmology Mission
Euclid Finland	Euclid Cosmology Mission (Finland)
EU-OPENSOURCE	European Infrastructure of Screening Platforms for Chemical Biology
EU-OPENSOURCE Finland	European Infrastructure of Screening Platforms for Chemical Biology (Finland)
Euro-Argo	Global Ocean Observing Infrastructure
FAIR	Facility for Antiproton and Ion Research
FGCI	Finnish Grid and Cloud Infrastructure
FinELib	The Finnish National Electronic Library
FINMARI	Finnish Marine Research Infrastructure
Finna	Public Interface Finna of the National Digital Library
FMAS	Finnish Microdata Access Services
GBIF	Global Biodiversity Information Facility
ICDP	International Continental Scientific Drilling Program
ICOS	Integrated Carbon Observation System
ICOS Finland	Integrated Carbon Observation System (Finland)
IIASA	The International Institute for Applied Systems Analysis
IML	Institut Mittag Leffler
INAR RI	Integrated Atmospheric and Earth System Science Research Infrastructure
INCF	International Neuroinformatics Coordination Facility
INFRAFRONTIER	The European Infrastructure for Phenotyping and Archiving of Model Mammalian Genomes
INFRAFRONTIER Finland	The European Infrastructure for Phenotyping and Archiving of Model Mammalian Genomes
Instruct	Integrated Structural Biology Infrastructure
Instruct Finland (ICVIR)	Integrated Structural Biology Infrastructure (Finland)
IODP	Integrated Ocean Drilling Program
ITER	International Thermonuclear Experimental Reactor
JHR MTR	Jules Horowitz Materials Testing Reactor
JYFL-ACCLAB	Accelerator Laboratory of the University of Jyväskylä
Lifewatch	Science and Technology Infrastructure for Research on Biodiversity and Ecosystems
MAX IV	MAX IV Laboratory for Synchrotron Radiation Research
NaPPI	National Plant Phenotyping Infrastructure
NelC	Nordic e-Infrastructure Collaboration
NOT	Nordic Optical Telescope
NVVL	National Virus Vector Laboratory
oGIIR	Open Geospatial Information Infrastructure for Research
OtaNano	Otaniemi micro and nanotechnology research infrastructure
PRACE	Partnership for Advanced Computing in Europe
PRACE Finland	Partnership for Advanced Computing in Europe (Finland)
TTA and KDK-PAS	National Research Data Initiative (TTA) and KDK-PAS (National Digital Library Initiative – Long-Term Preservation Project), national infrastructure services
XFEL	European X-ray Free-Electron Laser
XFEL and XBI	European X-ray Free-Electron Laser, XFEL and its Integrated Biology Infrastructure, XBI

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1 RESEARCH INFRASTRUCTURE STRATEGY

1.1 INTRODUCTION

1.1.1 Definition of research infrastructure

Research infrastructures form a reserve of research facilities, equipment, materials and services. As such, they enable research and development at various stages of innovation, while supporting organised research, researcher training and teaching. They also support and develop research and innovation capacity.

Research infrastructures consist of equipment, knowledge networks, databases, multidisciplinary research centres, research stations, collections, libraries and the related user services, where these are fundamental to research. In general, major research infrastructures are international and open to collaborative use, providing cooperation possibilities to researchers both abroad and in Finland.

Research infrastructures can be centralised, that is, based in a single location. They can also be distributed or virtual, and can form mutually complementary entities and networks.

1.1.2 Research infrastructure ecosystem

Finland's research infrastructure ecosystem includes major national research infrastructures, partnerships of Finnish actors in European infrastructure projects (ESFRI), international research infrastructures that Finland has joined through state agreements or other agreements, and local infrastructures denoted as significant by their host research organisations (Figure 1). Finland's Strategy and Roadmap for Research Infrastructures 2014–2020 steers the development of all parts of this ecosystem. The roadmap includes research infrastructures selected on the basis of an international evaluation, that is, research infrastructures of national significance, 18 of which are ESFRI partnerships.

1.2 ROADMAP FOR NATIONAL RESEARCH INFRASTRUCTURES

Finland's roadmap for national research infrastructures is a plan for key research infrastructures in Finland, which are either under development or will be newly required over the next 10–15 years. The plan also concerns a major upgrade of existing research infrastructures. Participation in new international projects and major overhauls and expansions of projects involving international cooperation, as well as memberships of international research infrastructures, are included in the roadmap.

1.2.1 Roadmap published in 2009

The first Finnish research infrastructure roadmap was published in 2009. A total of 24 major research infrastructure projects (Reference 1) by national actors were selected for this roadmap. Of these, 13 formed part of European roadmap projects under the European Strategy Forum on Research Infrastructures (ESFRI). The committee for the 2009 roadmap made 25 recommendations on how Finland's research infrastructure policy might be developed. Its key observations concerned the achievement of greater consensus and closer cooperation between ministries, funding agencies, universities and other research infrastructure host organisations, and the scientific community. Another important area of development was the opening up of national materials and registers for wider international use, for example, by stepping up the digitalisation of materials.

The 2009 roadmap and its recommendations resulted in a broader discussion of Finland's research infrastructures. In autumn 2011, Finland's Ministry of Education, Science and Culture assigned the task of administering the country's national research infrastructure policy to the Academy of Finland. The Academy was to establish a broad-based committee of experts for this purpose. Accordingly, the Finnish Research Infrastructure Committee (FIRI Committee) was established in spring 2012. It comprises key actors in research infrastructure policy, such as representatives of the Academy of Finland; the Ministry of Education, Science and Culture; the Ministry of Employment and the

Economy; the Ministry of Social Affairs and Health; Tekes – the Finnish Funding Agency for Innovation; Finnish universities; Universities Finland UNIFI; state research institutes; the Council of Research Institute Directors and the Rectors' Conference of Finnish Universities of Applied Sciences. Provision has been made in the state budget for the funding of research infrastructures, the administration of such funding having been assigned to the FIRI committee of the Academy of Finland.

1.3 EUROPEAN RESEARCH INFRASTRUCTURES

The development of research infrastructures is one of the priorities under the European Union's research policy. At national level, research infrastructures are viewed as part of overall research and innovation policy, which includes charting the significance of the global, European, Nordic and national dimensions. International research infrastructure projects are considered at meetings of the OECD's Global Science Forum, the European Strategy Forum on Research Infrastructures (ESFRI), the Nordic Council of Ministers and various bodies of experts such as the FIRI Committee. At these forums, proposals for new projects are presented, the social significance and impact of projects – and their scientific and technological potential – are evaluated, the level of interest in the projects' implementation is charted and their costs are assessed.

ESFRI has drawn up roadmaps, for joint European research infrastructures. The first roadmap report was published in 2006 and updated in 2008 and 2010. ESFRI's upgraded roadmap of 2008 included 50 projects. By 2010 there were 38, due to ten ESFRI projects moving into the construction phase and two remaining unimplemented. Finnish research teams have been involved in the preparation, construction and implementation phases of 24 ESFRI projects (References 2-4).

Several European countries, such as the Netherlands, France, Germany, Norway, Denmark and Sweden, have recently published their own roadmaps or roadmap upgrades. According to the ESFRI roadmap and national roadmaps, international cooperation is assuming a key role in the development of European research. The most effective way of improving the global competitiveness of the European Economic Area lies in pooling resources and engaging in cooperation with countries outside as well as inside

Opportunities provided to Finland and Finnish science by research infrastructures

Research infrastructures support internationally high-level research and increase the critical mass of research communities.

Research infrastructures enhance the basis for research, development and innovation activities, spurring the high-tech industry to develop products and services.

Research infrastructures bolster research expertise, create business ideas and jobs and boost seed-stage entrepreneurial activities by supporting pilot and demo projects, for example.

Combined with well-organised management and funding, the collaborative use of research infrastructures enables cost-effective, high-quality operations throughout the research infrastructure's lifecycle.

Research infrastructures increase the international integration of Finnish research, for example, by providing access to networks of cutting-edge international expertise.

Research infrastructures create a research environment in Finland that is more attractive to excellent researchers from both Finland and abroad.

Research infrastructures promote open access to research data.

Europe. Broad international collaboration is characteristic of research infrastructures. Of the projects selected for the Finnish research infrastructure roadmap 2014-2020, 15 were also on the latest ESFRI roadmap, whereas 13 ESFRI projects appeared on Finland's national roadmap in 2009.

The Nordic Council of Ministers and its sub-organisation, NordForsk, develop research infrastructure collaboration at Nordic level and seek to improve the use of such infrastructures while linking them with their European and global equivalents (Reference 5).

1.4 OPPORTUNITIES AND CHALLENGES FOR FINLAND'S RESEARCH INFRASTRUCTURES

Frontier research requires state-of-the-art infrastructures. At their best, research infrastructures are

Challenges to the systematic development of research infrastructures

A long-term and broad-based policy that takes account of the strategies of universities and other actors is still under development and underfunded.

The existing funding instruments for research infrastructures do not provide effective support for the collaborative use of the infrastructures.

At both national and international level, prioritisation of research infrastructures has yet to be achieved.

Insufficient use is made of research infrastructures at the level of society in general and too few opportunities are being created for new commercial innovations.

A higher level needs to be achieved in the quality, research community expertise, user numbers and internationality of research infrastructures.

A step-up is required in collaborative use of and collaborative access to research infrastructures, and in their administration of information content.

Mechanisms are lacking for identifying the gaps.

Monitoring of and reporting on research infrastructure activities are inadequate.

dynamic and open physical or virtual research community structures that cross disciplinary boundaries. They attract international top-flight researchers, provide training and teaching, and enable innovations in partnership with entrepreneurs, companies and industry. A sound research infrastructure ecosystem includes local, national and international research infrastructures of various size categories, complementing and supporting one another.

New business concepts and jobs for top talents in any given sector are created by the process of building research infrastructures and their activities. Examples of this include the European ESRF and Max IV accelerators built to facilitate international material research, and in whose vicinities new innovations and companies have sprung up. The creation of research infrastructures provides companies with the opportunity to upgrade their technology, boost their competitiveness, obtain useful contacts and raise their profiles. The key opportunities provided by research infrastructures from Finland's perspective, are listed in the table on page 9.

The economic and social development of Finland and Europe is ever more dependent on research and on research-based innovations. One of the key tasks of research infrastructures is to facilitate and support top-level research and business, improving the ability of society to respond to the major challenges of the future, such as climate change, and issues related to environmental and energy questions, health and well-being and intercultural dialogue. As they develop, national research infrastructures and infrastructure policy are being confronted by a number of challenges. The key challenges of research infrastructures and research infrastructure policy of Finland are listed in the table on page 10.

A consistent research infrastructure policy is required for the systematic development of research infrastructures, which takes account of the activities of host organisations and other stakeholders, as well as national operational strategies. The creation of links with potential partners will be important in the planning and construction phase, so that all actors, including companies, can be more closely involved in the establishment and maintenance of research infrastructures.

1.5 VISION

By 2020, Finland will have gained recognition for its internationally competitive science and high-quality research infrastructures, which enable the renewal of learning, society and the business sector.

1.5.1 Necessary basis for achieving the vision

In order to fulfil this vision, the following actions will be required:

1. **Long-term development of all research infrastructures**
 - a. Development and maintenance plans for small, medium-sized and large research infrastructures will be included in the strategic plans of research organisations.
 - b. Greater attention will be paid to the opportunities that research infrastructures provide for the renewal of the science base and business sector, the boosting of competitiveness and the further development of society.

- c. Steps will be taken to ensure that no gaps prevail within the activities of interrelated research infrastructures and that existing national research infrastructures are of a sufficiently high quality, in order to support the optimal use of international research infrastructures.

2. Improvements of access to and collaborative use of research infrastructures

- a. Collaboration between actors will be promoted so as to enable the realisation of the research and innovation potential provided by research infrastructures, in the development of Finnish business life and society.
- b. The collaborative use of and access to research infrastructures will be systematically promoted between various actors, universities, research institutes, hospitals and companies, by developing collaboration mechanisms and creating new innovation ecosystems.
- c. Research infrastructure solutions that promote the creation of open science and knowledge will be developed.
- d. The utilisation rate of research infrastructures will be raised.

3. Shoring up of the funding base of research infrastructures

- a. Sufficiently long-term and effectively targeted research infrastructure funding will be secured, while acknowledging that such funding from the Academy of Finland can only cover part of the funding needs.
- b. Collaboration on research infrastructure funding with ministries, universities, research institutes, hospitals, companies and foundations will be extended.
- c. Funding systems will be rendered more clearly supportive of collaborative activities.
- d. At national and organisational level, a funding plan will be drawn up that takes into account possible changes in the lifecycle and characteristics of research infrastructures.

4. Provision of a firm basis, by the roadmap, for the methodical development of research infrastructures

- a. Major projects will be selected for the roadmap and prioritised to ensure a high level, both nationally and internationally, in terms of the renewal of the research infrastructure ecosystem, the quality of knowledge created and the impact of research infrastructures.
- b. The scope of projects selected will cover all key disciplines and support the implementation of strategies related to Finland's national science and research policy.
- c. The roadmap will enable Finland to actively influence ESFRI prioritisation.
- d. The implementation of the research infrastructure strategy and the progress of research infrastructures selected for the roadmap will be reviewed every three years.

5. Evaluation of the impact and significance of research infrastructures

- a. The impact, significance and collaborative use of research infrastructures will be subject to regular evaluation.
- b. Decisions on the continuation of international and national research infrastructures of importance to Finland will be based on a systematic evaluation method.
- c. Evaluations will be performed of the direct or indirect benefits of national or important international research infrastructures to Finnish research, business and society. In developing such evaluations, account will be taken of the fact that the nature of research infrastructures may change due to developments in science and technology such as new digital breakthroughs.

2 FINLAND'S RESEARCH INFRASTRUCTURE ECOSYSTEM

The Finnish research infrastructure ecosystem includes 1) major national research infrastructures, 2) partnerships of Finnish actors in European infrastructure projects (ESFRI), 3) international research infrastructures that Finland has joined through state or other agreements, and 4) local infrastructures denoted as significant by their host research organisations (Figure 1). Finland's Strategy and Roadmap for Research Infrastructures 2014–2020 includes research infrastructures selected through international evaluation, 18 of which are ESFRI partnerships.

2.1 MAJOR NATIONAL RESEARCH INFRASTRUCTURES

A total of 31 national research infrastructures have been selected for Finland's research infrastructure roadmap 2014–2020, 18 of which are ESFRI partnerships. In addition, there are two projects selected for the roadmap that have potential to develop into major national research infrastructures. Each of these is described in chapter 3.

2.2 PARTNERSHIPS WITHIN ESFRI RESEARCH INFRASTRUCTURES

ESFRI (the European Strategy Forum for Research Infrastructures) is a strategic collaborative body supported by EU member states and the European Commission. ESFRI seeks to develop research integration across national boundaries and to strengthen Europe's competitiveness at the forefront of scientific research. High-quality research infrastructures based on open access provide the basis for high-quality research with a public impact and for attracting the best researchers to Europe. ESFRI has charted the key European research infrastructures, adding 50 of them to its roadmaps for 2006, 2008 and 2010 (References 2–4). ESFRI promotes implementation of the roadmap's most developed research infrastructures and to update the 2010 roadmap. Finnish research communities have been partners in the development of half of ESFRI's 50 projects (Figure 2 and Table 1). Partnerships have been based on Finland's membership of international organisations, its desire to have a say in the preparatory phase of projects or its aim to achieve a leading position in research infrastructures under construction.

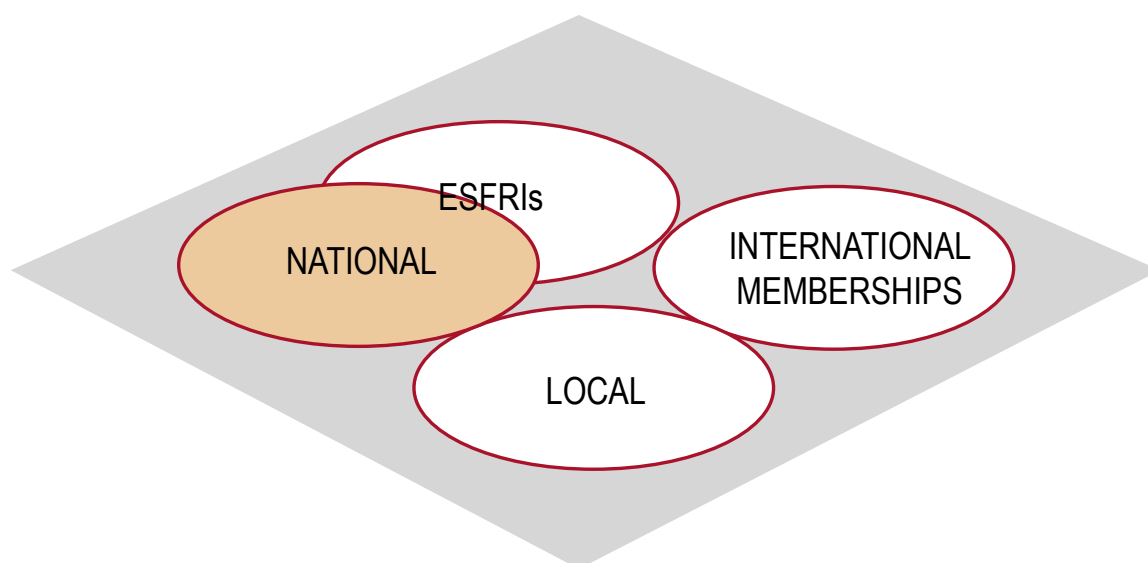


Figure 1. Finland's research infrastructure ecosystem

Finland's research infrastructure roadmap 2014–2020 includes 31 major national research infrastructures, 18 of which are ESFRI partnerships (orange area).

Social Sc. & Hum. (5)	Life Sciences (13)		Environmental Sciences (9)		Energy (7)	Material and Analytical Facilities (6)	Physics and Astronomy (10)		e-Infra-structures (1)
SHARE	BBMRI	ELIXIR	ICOS	EURO-ARGO	ECCSEL	EUROFEL	ELI	TIARA	PRACE
European Social Survey	ECRIN	INFRAFRONTIER	LIFEWATCH	IAGOS	Windscanner	EMFL	SPIRAL2	CTA	
CESSDA	Instruct	EATRIS	EMSO	EPOS	EU-SOLARIS	European XFEL	E-ELT	SKA	
CLARIN	EU-OPENSCREEN	EMBRC	SIOS	EISCAT_3D	JHR	ESRF Upgrade	KM3NeT	FAIR	
DARIAH	EuroBio-Imaging	ERINHA-BSL4 Lab		COPAL	IFMIF	NEUTRON ESS	SLHC-PP	ILC-HIGRADE	
	ISBE	MIRRI			HiPER	ILL20/20 Upgrade			
	ANAE				MYRRHA				

Distributed research infrastructure
 Single sited research infrastructure

Figure 2. Projects on the ESFRI 2010 roadmap

Distributed infrastructures (light grey) and single-site infrastructures (dark grey). Finnish research infrastructures form part of 25 infrastructures featured on the ESFRI 2010 roadmap (ringed in Figure 2, column B of Table 1). Finland has been selected as the national centre for 19 of these for the 2014–2020 roadmap (FINMARI, selected for the Finnish research infrastructure roadmap 2014–2020, is a partner in two projects on the ESFRI 2010 roadmap).

Extended research infrastructures shared by several states have complex structures and are challenging to administer. In order to harmonise the related judicial practices, the EU has drawn up a regulation (European Consortium on Research Infrastructures, ERIC) establishing a legal framework for research infrastructures. This is intended to ease the administration and operations of extensive multidisciplinary research infrastructures. Some research infrastructures featured on the ESFRI roadmaps have adopted legal forms different to that of ERIC. The specified legal form of the ELIXIR research infrastructure is the “ELIXIR Consortium

Agreement” (ECA Agreement). The INFRAFRONTIER research infrastructure is a non-profit private limited company (INFRAFRONTIER GmbH).

Because these agreements impose financial obligations on each participating country, approval of and commitment to the related memoranda of association for what is, in most cases, five years, requires careful consideration and the ranking of national research infrastructures in order of priority and urgency. The tasks of the FIRI Committee include the coordination, follow-up and development of Finland’s national research infrastructure policy,

Table 2. The FIRI Committee has nominated Finland for following memberships within ESFRI research infrastructures.

Abbreviation	Name of the research infrastructure
BBMRI	Biobanking and Biomolecular Resources Research Infrastructure
CESSDA	Consortium of European Social Science Data Archives
CLARIN	Common Language Resource and Technology Infrastructure
EATRIS	European Advanced Translational Research Infrastructure in Medicine
ELIXIR	European Life Science Infrastructure for Biological Information
ESS	European Social Survey
ICOS	Integrated Carbon Observation System
INFRAFRONTIER	The European Infrastructure for Phenotyping and Archiving of Model Mammalian Genomes
Instruct	Integrating Structural Biology

covering the drafting of proposals for the participation of Finnish research infrastructures in international research infrastructure collaboration. To date, the FIRI Committee has presented the ministries concerned with a proposal that Finland become a member of nine ESFRI roadmap research infrastructures (Table 2), act as the host country of ICOS ERIC and meet the costs of membership and hosting activities. Such costs will total an estimated five million euros per year in the first five years. Several other national centres for research infrastructures on the ESFRI roadmap have been selected for the Finnish research infrastructure roadmap 2014–2020. Decisions on these centres have not yet been made.

2.3 INTERNATIONAL RESEARCH INFRASTRUCTURES

In addition to ESFRI infrastructures, Finland is a member of 18 international research infrastructures, through various treaties and other agreements. In 2013, membership fees totalled around 40 million euros. Fees related to infrastructures and the associated memberships are listed in Table 3.

2.4 RESEARCH ORGANISATIONS' LOCAL RESEARCH INFRASTRUCTURES

To obtain an overall picture of strategically important infrastructures at the local level, a survey was addressed

Table 3. Finnish memberships within international research infrastructures

	International research infrastructure	Membership fee 2013 (€)	The type of contract
Environmental sciences	EISCAT European Incoherent Scatter Association	356 650	AF-contract *
	GBIF Global Biodiversity Information Facility	62 700	the Ministry level contract
	ICDP International Continental Scientific Drilling Program	23 364	AF-contract *
	IODP Integrated Ocean Drilling Program	51 698	AF-contract *
Energy	EFDA-JET Joint European Torus	97 000	as EU member
	ITER International Thermonuclear Experimental Reactor	63 100	as EU member
	JHR MTR Jules Horowitz Materials Testing Reactor	1 000 000	VTT-contract
Biological and medical sciences	EMBL European Molecular Biology Laboratory	1 375 819	the Treaty
	EMBC European Molecular Biology Conference	229 203	
	INCF International Neuroinformatics Coordination Facility	92 000	AF-contract *
Material sciences and analytics	ESRF European Synchrotron Radiation Facility	723 207	the Treaty**
Natural sciences and technology	CERN European Organization for Nuclear Research	12 616 366	the Treaty
	ESA European Space Agency	19 470 264	the Treaty
	ESO European Southern Observatory	2 095 000	the Treaty
	FAIR Facility for Antiproton and Ion Research**	589 700	the Treaty***
	NOT Nordic Optical Telescope	423 100	AF-contract *
E-Science and mathematics	IML Mittag-Leffler Institute	50 000	AF-contract *
	NeIC Nordic e-Infrastructure Collaboration	413 000	AF-contract *
Others	IIASA The International Institute for Applied Systems Analysis	648 000	the Ministry level contract
In total		39 377 471	

* Signed by the Academy of Finland

** in NORDSYN consortium

*** in FAIR NORD consortium, construction costs

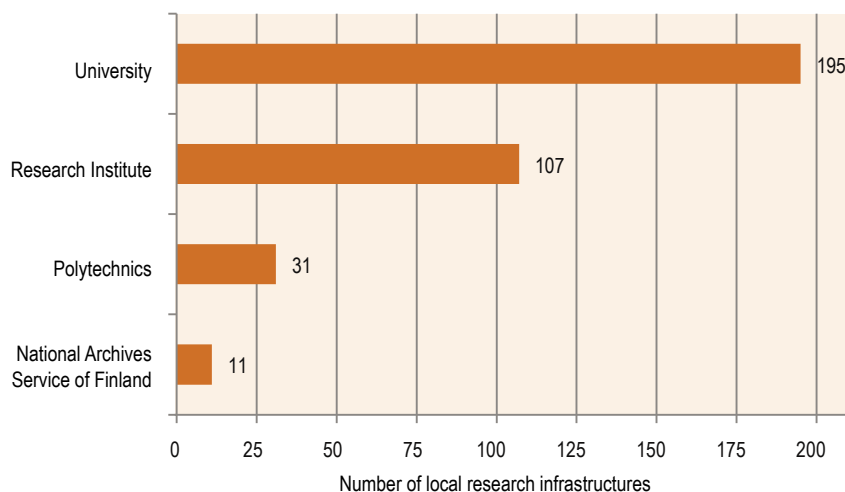


Figure 3. Number of local research infrastructures, by host organisation

to universities, government research institutes, polytechnics, the National Archives Service of Finland and the CSC – IT Center for Science (Figure 3). The results provided a picture of the key local research infrastructures of research organisations, including those serving research conducted in university hospitals (Reference 6). The responses to the survey named a total of 519 research infrastructures of all 14 universities, 15 government research institutes, 17 polytechnics, the National Archives Service of Finland and CSC. On the basis of the results, a total of 344 research infrastructures were adjudged to be local, of which 195

(57%) are based within universities, 107 (31%) within research institutes, 31 (9%) within polytechnics and 11 (3%) within the National Archives Service of Finland (Table 3).

Local infrastructures most frequently exist within the bio- and health sciences (87) and within the natural sciences and engineering (79). The energy sector is thinly represented among local research infrastructures (7), as also are the e-science and mathematics sectors with only seven local infrastructures. This is due to the fact that, IT research infrastructure services are mainly centralised in the CSC

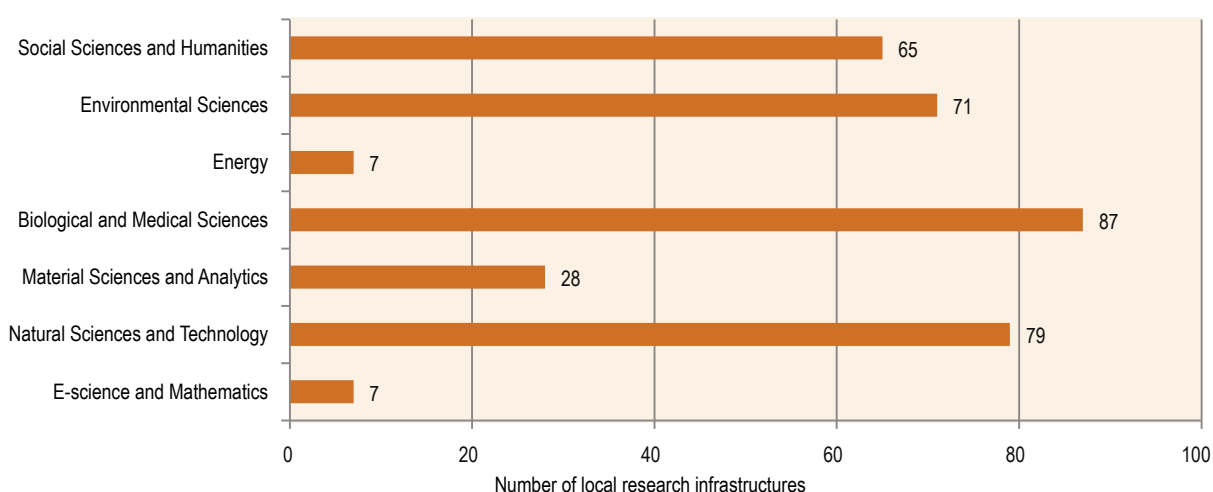


Figure 4. Number of local research infrastructures, by discipline

– IT Center for Science. Figure 4 lists the number of local research infrastructures by discipline.

2.5 FUNDING REQUIREMENTS OF FINLAND'S RESEARCH INFRASTRUCTURES

Research infrastructures are funded by their host organisations, a range of ministries, Tekes – the Finnish Funding Agency for Innovation, and the Academy of Finland. The Academy funds research infrastructures in the form of international membership fees and targeted research infrastructure funding. The Academy can also grant funding for research infrastructure operating costs, from funding allocated to research projects.

The total estimated annual costs faced by research infrastructures include direct membership fees, obligatory costs associated with membership, investments and other costs. As a rough estimate, the average annual national funding requirement for the roadmap (Table 1, column A), ESFRI partnerships (column B) and international research infrastructures (column C) will total 260 million euros in 2014–2018. This estimate does not include local infrastructures (Table 1, column D) or ESFRI roadmap infrastructures (LIFEWATCH; ECRIN) whose national centres were not selected for the roadmap. The funding requirements of roadmap infrastructures are itemised in the project descriptions (sections 3.2.1–3.2.6). Table 4 presents the distribution of costs between disciplines and research infrastructures.

Table 4. Estimated national funding requirement for research infrastructures, by discipline

	National research infrastructures of the Roadmap (no)	Partnerships of Finnish actors in ESFRI projects (no)	International research infrastructures which Finland has joined through state or other agreements (no)	The total estimated annual costs for Finland (€)*
Social Sciences and Humanities	7	3	0	80 000 000**
Environmental Sciences	6	7	4	50 000 000
Energy	-	1	3	1 000 000
Biological and Medical Sciences	10	8	2	45 000 000
Material Sciences and Analytics	3	2	1	15 000 000
Natural Sciences and Technology	4	3	5	60 000 000
E-Science and Mathematics	3	1	2	12 000 000
Others	-	-	1	650 000
In total	33	25	18	183 650 000

* Information is based on the estimated annual costs between the years 2014–2018

** Several of the infrastructures in the field of humanities provide services to researchers from all disciplines

3 FINLAND'S RESEARCH INFRASTRUCTURE ROADMAP 2014–2020

3.1 SELECTION PROCESS AND CRITERIA FOR RESEARCH INFRASTRUCTURES

The Finnish research infrastructure roadmap 2014–2020 is a plan covering newly required research infrastructures, those in the construction phase and the major overhaul of existing infrastructures over the next 10–15 years. A total of 31 projects required for research and innovation in the disciplines in question have been selected for the 2014–2020 roadmap. When making funding decisions related to research infrastructures, the Academy of Finland will take into account the development needs of projects selected for the roadmap.

Proposals by the research organisations, on research infrastructures to be included on the roadmap, were evaluated in a two-stage process by international panels of experts (Appendix 3). On the basis of the panel's assessments, the FIRI Committee decided on the research infrastructures to be selected for the roadmap (Figure 5).

The evaluations of the proposals sought to identify international-level research infrastructures that support the attainment of Finland's research and innovation policy goals. Projects selected for the roadmap were to create added value in research terms and markedly lift the quality

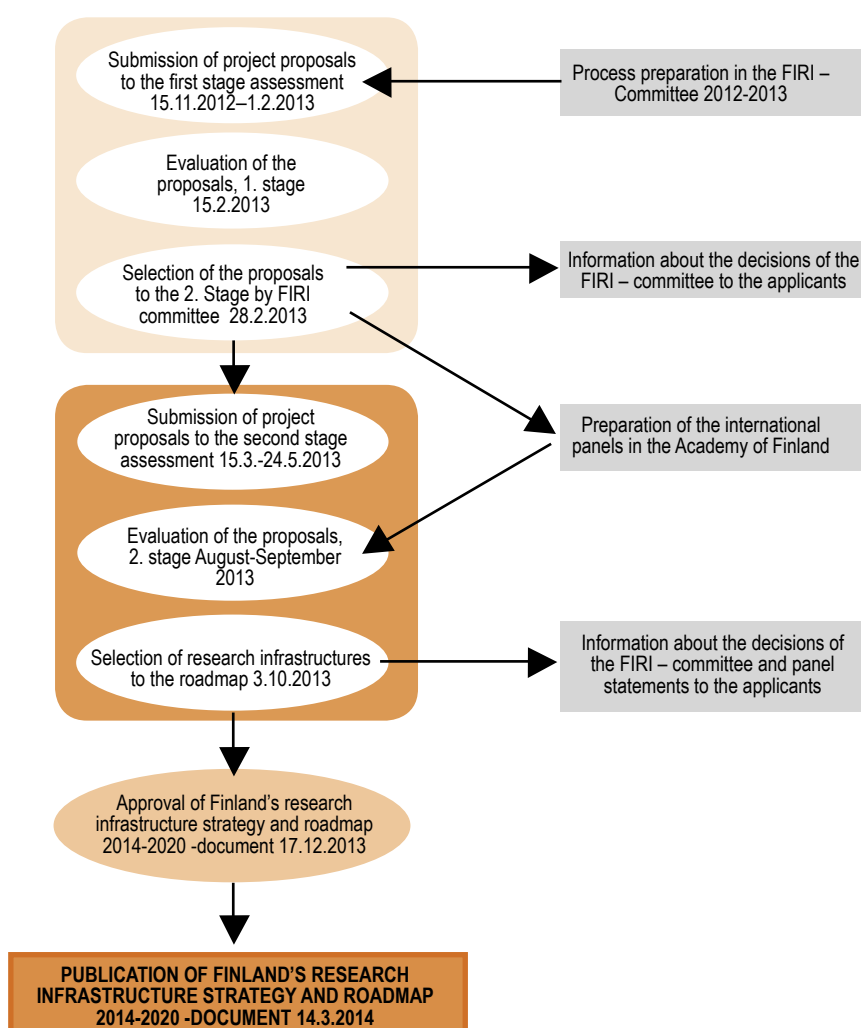


Figure 5. Selection process

The infrastructure proposals were assessed by an international panel in a two-stage process. In the first stage, the assessment panel selected the proposals that would pass through to the next round. The second stage involved evaluations by international panels representing the disciplines in question. These panels also interviewed the applicants. The FIRI Committee then decided on the research infrastructures to be included in the roadmap.

of research in Finland within the discipline in question. They were also to attract excellent researchers to Finland. When assessing the potential for the successful realisation of each research infrastructure, the panel members took into account the scope of the potential user community, multidisciplinary coverage, multi-sectoral reach and quality. All criteria were interpreted from Finland's perspective. However, when weighing up participation in international research infrastructures, the

panel assessed the quality and impact of research from the viewpoint of international needs. Appendix 4.1 and includes description of the evaluation criteria applied.

3.2 NATIONAL RESEARCH INFRASTRUCTURES

Finland's national research infrastructures are either single-site, distributed or virtual. They may form mutually complementary entities or networks.

Table 5. National research infrastructures featured on the roadmap, by discipline

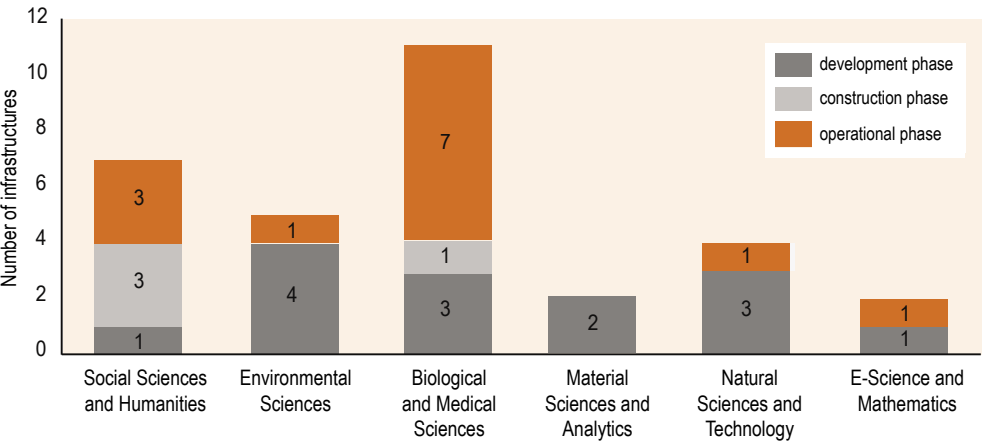
	Abbreviation	Research Infrastructure name in full	ESFRI*
Social Sciences and Humanities	ESS Finland	European Social Survey	x
	FIN-CLARIN	Common Language Resources and Technology Infrastructure	x
	Finna	Public Interface Finna of the National Digital Library	
	FinELib	The Finnish National Electronic Library FinELib	
	FMAS	Finnish Microdata Access Services	
	FSD ja CESSDA	The Finnish Social Science Data Archive and Consortium of European Social Science Data Archives	x
	TTA and KDK-PAS	Finnish Information Infrastructure Services	
Environmental Sciences	EISCAT_3D Finland	EISCAT_3D (Finland), ISR (incoherent scatter radar) system	x
	FIN-EPOS	European Plate Observing System	x
	FINMARI	Finnish Marine Research Infrastructure	x
	ICOS Finland	Integrated Carbon Observation System (Finland)	x
	INAR RI	Integrated Atmospheric and Earth System Science Research Infrastructure	x
	oGIIR**	Open Geospatial Information Infrastructure for Research**	
Biological and Medical Sciences	BBMRI.fi	Biobanking and Biomolecular Resources Research Infrastructure	x
	Biocenter Finland	Distributed National Research Infrastructure of Finnish Biocenters	
	EATRIS Finland	European Advanced Translational Research Infrastructure in Medicine (Finland)	x
	ELIXIR Finland	European Life Science Infrastructure for Biological Information (Finland)	x
	EuBI Finland	Euro-BioImaging (Finland)	x
	EU-OPENSOURCE Finland	European Infrastructure of Screening Platforms for Chemical Biology (Finland)	x
	INFRAFRONTIER Finland	The European Infrastructure for Phenotyping and Archiving of Model Mammalian Genomes (Finland)	x
	Instruct Finland	Integrated Structural Biology Infrastructure (Finland)	x
	NaPPI	National Plant Phenotyping Infrastructure	
	NVVL	National Virus Vector Laboratory	
Material Sciences and Analytics	MAX IV	MAX IV Laboratory for Synchrotron Radiation Research	
	OtaNano	Otaniemi Micro and Nanotechnology Research Infrastructure	
	XFEL ja XBI	European X-ray Free-Electron Laser, XFEL and its Integrated Biology Infrastructure, XBI	x
Natural Sciences and Technology	BIOECONOMY	Alliance for Excellence in Sustainable Biomass Refining	
	CTA	Cherenkov Telescope Array	x
	Euclid	Euclid Cosmology Mission	
	JYFL-ACCLAB	Accelerator Laboratory of the University of Jyväskylä	
E-Science and Mathematics	CSC RI	CSC RI - a Finnish e-Infrastructure	
	PRACE Suomi	Partnership for Advanced Computing in Europe	x
	FGCI**	Finnish Grid and Cloud Infrastructure**	

* Partnerships within ESFRI research infrastructures

** Potential project

Derived from column A of Table 1, Table 5 lists the 31 national research infrastructures as well as two projects selected for the research infrastructure roadmap that have potential to develop into major national research infrastructures.

Figure 6. Stage of completion of national research infrastructures, by discipline
 Of the research infrastructures selected for the roadmap, five (16%) are in the development phase, 12 (39%) have moved into the construction phase and 14 (45%) are in the operational phase.



Because the construction of research infrastructures is long and multi-phased, their stage of completion tends to vary. Figure 6 presents the stage of completion of national infrastructures, by discipline.

Descriptions of the Finnish 31 research infrastructures and two potential projects are in sections 3.2.1-3.2.6.



3.2.1 Social sciences and humanities

Research infrastructures in the social sciences and humanities provide a range of services such as social science indicators, language banks, open libraries, databases and registers. Seven major

national research infrastructures are recognised within the social sciences and humanities disciplines. Of these, three form part of the ESFRI roadmap projects.

RESEARCH INFRASTRUCTURES FOR THE SOCIAL SCIENCES AND HUMANITIES:

[ESS \(Finland\), European Social Survey](#)

[FIN-CLARIN, Common Language Resources and Technology Infrastructure](#)

[FinELib, Finnish National Electronic Library](#)

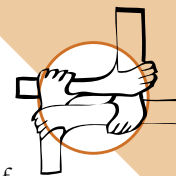
[Finna, Public Interface of the Finnish National Digital Library](#)

[FMAS, Finnish Microdata Access Services](#)

[FSD and CESSDA, Finnish Social Science Data Archive and Consortium of European Social Science Data Archives](#)

[National Research Data Initiative \(TTA\) and KDK-PAS \(National Digital Library Initiative – Long-Term Preservation Project\)](#)

[National Infrastructure Services](#)



ESS (FINLAND), EUROPEAN SOCIAL SURVEY

National coordination: Faculty of Social Sciences,
University of Turku

Host country of the ESFRI research infrastructure:
United Kingdom

Number of participating states: 36

Timetable:

- **Construction phase:** 2002–
- **Operation phase:** 2002–
- **Other important dates:** 2013 ERIC (The Education Resources Information Center) agreement

Estimated cost:

- **Cost to Finland:** membership fees 47,000 euros per year for 2014–19
- **Total cost:** 3.27 million euros per year for 2014–19

Website: <http://www.europeansocialsurvey.org/>

Background

The European Social Survey (ESS) is an academically driven cross-national survey that charts and explains the relationships between the attitudes, beliefs and behaviour patterns of Europe's institutions and peoples as the latter change. The ESS applies extremely high standards of methodological rigour across the board from questionnaire design and sampling, to fieldwork methodologies and the archiving of material. Key survey subjects include general value orientations, political participation and attitudes, social capital and trust in social institutions, as well as issues related to health and healthcare-related behaviour. The special themes of Round 6, held in 2012–13, were European beliefs and values concerning democracy, and subjective and social wellbeing.

Services provided by the research infrastructure

In addition to content-based research, the ESS aims to develop indicators for quantitative, comparative social research both in Europe and around the world. As well as the more traditional economic indicators, the ESS is developing a set of social indicators measuring the quality of life in different countries and regions. The survey covers 36 states and its results are at the disposal of all researchers in the social sciences and other disciplines in over 160 countries. This material is freely and directly available – without restriction – via the internet. The ESS has provided material resources for hundreds of peer-reviewed articles and academic books.

Structure of national research infrastructure

Material has been gathered for the ESS survey project every second year since 2002. The latest survey files were published in October 2013. Finland has been

involved from the very beginning and its database is of a high quality. The ESS was on the national research infrastructure roadmap of 2009. National activities associated with the ESS are coordinated by the University of Turku.

Participation in the ESS research infrastructure provides Finnish social science researchers with a range of opportunities, by 'hooking them up' with the international social sciences research community and international research collaboration in general. Use of international material increases the possibility of publication in the most respected scholarly journals and serials. When Finnish society is placed within a broader, comparative context, it is rendered more interesting as a research subject.

FIN-CLARIN, COMMON LANGUAGE RESOURCES AND TECHNOLOGY INFRASTRUCTURE

National coordination: Department of Modern Languages,
University of Helsinki

Host country of the ESFRI research infrastructure:
The Netherlands

Number of participating states: 8 members + 1 observer member

Timetable:

- **Planning phase:** CLARIN 2007–2011, FIN-CLARIN 2006–2011
- **Construction phase:** CLARIN 2012–2021, FIN-CLARIN 2012–2021
- **Operation phase:** CLARIN 2022–, FIN-CLARIN 2022–
- **Other important dates:**
 - 2012 ERIC agreement
 - 2014 Finland joins CLARIN-ERIC

Estimated cost:

- **Cost to Finland:** membership fees 25,000 euros per year
- **Total cost:** 8.5 million euros per year for 2014–19

Websites of research infrastructure:

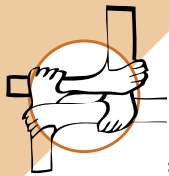
www.helsinki.fi/finclarin; www.clarin.eu

Websites of infrastructure services:

www.kielipankki.fi; www.tieteentermipankki.fi

Background

CLARIN is a European research infrastructure consortium, dedicated to creating a generally available and interoperable research infrastructure for language resources and language technology. The intention is to alleviate the fragmented nature of current research activities by providing a stable, permanent, intuitive and



scalable research infrastructure, in which researchers can work at their own workstations. Research and the related activities in the humanities will become more efficient, since CLARIN provides scholars with access to various domestic and foreign materials for the language under research. Efficiency will be boosted as the amount of available material multiplies within this international research infrastructure and as new tools expedite the discovery of solutions to research problems. Research in the humanities will become easier to reproduce and evaluate, as the language resources underlying research theses become accessible to all scholars. Researchers will be able to confirm or disprove the accuracy of claims, which will lead to better and more-reliable results. CLARIN-ERIC provides a technical framework, norms and practices which enable the easy and smooth collaborative use of language resources by a broad research community of international scholars within the EU.

Services provided by the research infrastructure

FIN-CLARIN provides two centralised services: The Language Bank of Finland and the Bank of Finnish Terminology in Arts and Sciences (BFT). The Language Bank provides scholars with access to extensive collections of digital language resources and tools. It serves a broad research community consisting of representatives of the humanities and social and computer science. The aim is to provide collections representing different eras, genres and regions, and language in its various manifestations such as in textual, sound, image and video form. These tools and materials will assist researchers, teachers and students in the various humanities disciplines such as those related to language, culture, literature and history and, to some extent, the social sciences and information sciences. Users in Finland, the other Nordic countries, Germany and the Netherlands can already access the Language Bank using the user ID and password assigned by their own university. Access will be extended to the whole of the EU as each country joins the eduGAIN service, which is seeking to interconnect identity federations.

The aim of the Bank of Finnish Terminology in Arts and Sciences (BFT) project is to create a permanent and continuously updated body of terminology covering all academic disciplines. The Bank of Finnish Terminology in Arts and Sciences (BFT) is an openly accessible online collaboration platform for experts from various disciplines. It is also a wiki-based web service, which enables the discussion of concept formation. Academic terminology is an indispensable prerequisite for academic discourse: the Bank of Finnish Terminology in Arts and Sciences (BFT) will bring terminology and scholars together in a centralised forum for terminology work. While developing Finnish as a scholarly language, by providing translation equivalents and through its multilingual feature the Bank will also assist users in finding parallel terminology in different languages. It will also help to increase understanding of academic work amongst the general public.

Structure of national research infrastructure

The European consortium is composed of the national research infrastructures of various countries. CLARIN-ERIC coordinates the implementation, development and securing of the compatibility and joint use of the language resources administered by each of these infrastructures. FIN-CLARIN, Finland's national research infrastructure, was founded in 2007 and was included on the national research infrastructure roadmap for 2009. Preparations for Finland's accession to CLARIN-ERIC have included the development of FIN-CLARIN's Language Bank as a common centralised service making use of internationally compatible systems. Finnish and European researchers can access material via the Language Bank. The volume of available material has been increased: more than five billion Finnish words and three billion in Finland Swedish are now available. On the roadmap, FIN-CLARIN has as a cooperating partner in the BFT. The BFT has been openly accessible on the internet since 2012. At the moment, it includes 23,000 terms from 20 academic theme areas and its content is continually accumulating through updates made by experts. Its key partner is the Federation of Finnish Learned Societies, which encourages member societies to participate in the terminology work. Scholars are issued with expert rights for the theme area in question, using which they can add content to the web service. All users registered under their own names can participate in the discussion. The FIN-CLARIN language consortium is coordinated by the University of Helsinki and its members include Aalto University, the University of Eastern Finland, the University of Jyväskylä, the University of Tampere, the University of Turku, the University of Vaasa, the University of Oulu, CSC – IT Center for Science Ltd and the Institute for the Languages of Finland (Kotus).

FINELIB, FINNISH NATIONAL ELECTRONIC LIBRARY

Coordination: National Library of Finland, University of Helsinki

National research infrastructure

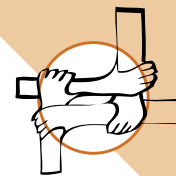
Timetable:

- **Construction phase:** 1997–1999
- **Operation phase:** 2000–
- **Other important dates:**
 - 2002 International assessment of FinELib
 - 2010 International assessment of National Library of Finland 2010

Estimated cost:

- **Total cost:** 20.8 million euros per year

Websites: <http://www.kansalliskirjasto.fi/kirjastoala/finelib/>;
<http://www.nationallibrary.fi/libraries/finelib/>



Background

The Finnish National Electronic Library, FinELib, is a consortium of Finnish universities, polytechnics, research institutes and specialist and public libraries. FinELib acquires both Finnish and international e-resources competitively, ensures the availability of diverse, high-quality electronic material and promotes the use of such material in research, teaching, learning and in the general acquisition of information. FinELib was on the national research infrastructure roadmap of 2009.

Services provided by the research infrastructure

The FinELib research infrastructure negotiates license agreements for electronic resources centrally, on behalf of its member organisations. Its centralised acquisition of electronic scholarly material for Finnish universities and around 40 research institutes is economical and creates the possibility to influence licensing terms. There has been rapid growth in the downloading of FinELib's licensed e-resources. A total of 24.5 million articles were downloaded in 2012. FinELib's license agreements provide access to 38,000 academic journals, 360,000 e-books, 112 reference databases and hundreds of reference works. Some 53 million searches and 8.3 million article downloads per year are performed through FinELib. Use of e-resources has helped users to find and access material and to keep abreast of developments in their field of research. It has also extended the range of resources available and saved working time.

Structure of national research infrastructure

The National Library of Finland is responsible for FinELib's operations and its development in accordance with the directions issued by the FinELib Steering Group. This is based on national and international cooperation and continuous development of the e-library. FinELib promotes cooperation between national libraries and enables top-flight expert and international cooperation with other resource-acquisition consortia. International cooperation enables innovation and increases the possibilities of impacting on academic publication activities. A strategic goal is to enhance open access to academic research results and other information. This goal has been pursued since 2012, through the national SCOAP3 project.

Finna, PUBLIC INTERFACE OF THE FINNISH NATIONAL DIGITAL LIBRARY

Coordination: National Library of Finland, University of Helsinki

National research infrastructure

Timetable:

- **Construction phase:** 2008–2016
- **Operation phase:** 2013–

Estimated cost:

- **Total cost:** 5.4 million euros per year for 2013–16

Website: <https://www.finna.fi/>

Background

Finna, the customer interface for Finland's national digital library, comprises a national web service and research infrastructure still under construction. It provides access to cultural and scholarly resources and services via a single service, and provides new possibilities for research and other creative activities. Finna was on the national roadmap for 2009. Although dozens of organisations were using Finna by the end of 2013, it will only offer a comprehensive range of scholarly and cultural resources by sometime in 2015–2016.

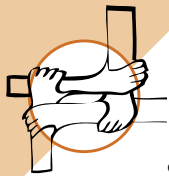
The National Digital Library is a unified collection of content and services, organised by sector and provided by the Ministry of Education and Culture. Its purpose is to secure effective and high-quality management, distribution and long-term preservation of cultural and scholarly digital data repositories. In addition, this project promotes the digitisation of documents and of material forming part of Finland's cultural heritage.

Services provided by the research infrastructure

The Finna research infrastructure includes material from archives, libraries and museums. Once all organisations have joined the service, researchers will be able to search for material via a single portal rather than dozens of individual catalogues and services. Among other materials, Finna includes images, databases, e-publications and metadata on physical material. It covers all fields of research, thereby supporting interdisciplinary research and creative approaches. In technical terms, the service is based on a number of open source code modules. The combination of these modules allows users and other owners or administrators of the research infrastructure to engage in cooperation. New modules and features can be added to the system later, as required.

Structure of national research infrastructure

The National Library of Finland is responsible for the development and maintenance of Finna. The Ministry of Education, Science and Culture develops the National Digital Library at sector level and directs its implementation and maintenance. Finna engages in broad-based cooperation with national and international academic and



cultural infrastructures, as well as with various projects, companies and research institutes. A long-term development plan has been drawn up for the Finna customer interface, under the guidance of a broad inter-sectoral consortium. The project has had a clear impact on the services of participating organisations, on technical infrastructures and on cooperation between libraries, archives and museums.

FMAS, FINNISH MICRODATA ACCESS SERVICES

Coordination: National Archives
National research infrastructure

Timetable:

- **Construction phase:** 2013–16
- **Operation phase:** 2015–

Estimated cost:

- **Total cost:** 7 million euros for 2014–19, i.e. 1.2 million euros per year

Website: <http://www.arkisto.fi>

Background

Officially maintained registers and statistical data form a nationally significant repository of research information. Since the bulk of these data consists of personal registers, their use by researchers is subject to special requirements. Use of such data is complicated by the fact that the registers are scattered between various branches of public administration, whereby each organisation administering the data has its own permission granting and data access procedures. Whenever they wish to combine information administered by several administrative bodies, researchers have to contact each authority separately.

Services provided by the research infrastructure

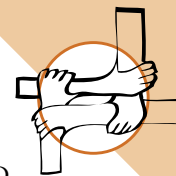
The Finnish Microdata Access Services, FMAS, has been designed to facilitate the use of register and statistical data at all phases of the research process. This service for researchers comprises four separate but inter-operating services that provide a single channel for the entire research process, from planning to data analysis. It includes a metadata catalogue that can be used to find information on the available data repositories, an electronic permit application service for obtaining permissions from various public authorities, a remote access system for the combination and analysis of various licensed data, and an information and support service providing assistance and advice on all issues related to register research.

The FMAS markedly simplifies finding, obtaining and using public administration data. It also enables improved protection of personal data throughout the lifecycle of register-based research data. The service is primarily intended for researchers, but a large number of other parties will benefit from it as well. The amount of register-based research increases when researchers can easily access information on the available register data and can use the data via a clear, single portal. The service provides an excellent environment for interdisciplinary cooperation between researchers and across institutional boundaries. As a teaching environment, the service provides access to register data for the teaching of research methods within universities and as material for theses of various levels. Because the quality of register-based research is high, increasing its amount will improve the quality and competitiveness of Finnish scientific research in general. For the research needed in societal decision-making, the service provides essential data via a well-functioning research infrastructure. The service also enables access to Finnish register data for users from abroad and can be developed into a form that supports comparative research on the Nordic countries.

Structure of national research infrastructure

The FMAS is a new research infrastructure under joint construction by the National Archives and Statistics Finland in 2014–2016. Researchers are being provided with the possibility to have a say in the creation of the service, via a web portal and development forum. Collaboration is also underway with the public administration organisations in charge of various data. Most of the new services will be commissioned by the end of 2015. In the years thereafter, they will be continuously complemented and developed.

The Micro Data Remote Access System, MIDRAS, evaluated as a potential infrastructure on Finland's national research infrastructure roadmap of 2009, has provided the main basis of the new service's development. Since then, the planning of MIDRAS has been continued in a separate evaluation project and by an interdepartmental work group. The new research infrastructure is also based on a remote service for statistical data, developed by Statistics Finland, and the services of the Finnish Information Centre for Register Researcher (ReTKi). These services will remain available to researchers until the commissioning of the new service.



FSD AND CESSDA, FINNISH SOCIAL SCIENCE DATA ARCHIVE AND CONSORTIUM OF EUROPEAN SOCIAL SCIENCE DATA ARCHIVES

National coordination: Finnish Social Science Data Archive (FSD), University of Tampere

Host country of the ESFRI research infrastructure: Norway

Number of participating states: 13 members + 10 observer members

Timetable:

- **Construction phase:** FSD 1999–, new CESSDA 2010–15
- **Operation phase:** 2016–
- **Other important dates:**
 - 1976–2013 cooperation begins
 - 2013 establishment of new CESSDA AS
 - 2014 ERIC (European Research Infrastructure Consortium) agreement

Estimated cost:

- **Cost to Finland:**
 - CESSDA membership fees 11,000 euros per year
 - core funding of FSD 1.1 million euros per year + supplementary funds for the expanding mandate 700,000 euros per year
- **Total cost:** 2 million euros per year

Websites: www.fsd.uta.fi; www.cessda.org; www.cessda.net

Background

CESSDA is a pan-European distributed research infrastructure whose operations are largely based on national service providers that is, social science data archives. The new CESSDA is building a comprehensive online European data repository and information services, which researchers can use to locate and easily access research data significant to their work. CESSDA provides relevant data for academic research and societal decision-making, enabling monitoring and problem-solving related to the challenges facing European countries and the global community.

Services provided by the research infrastructure

The Finnish Social Science Data Archive (FSD) is a national resource centre for research and teaching. It archives and disseminates Finnish and international electronic research data for research, teaching and study purposes, and provides information services on data-related issues. FSD services are being developed in cooperation with the key international organisations of the field. The services available on the FSD website include the data portal Aila with its data catalogues, information on research data management, and information on research methods.

The FSD has acted as the national service provider for the new CESSDA since 2013.

There are a number of development needs for the FSD in the requirements set by CESSDA: the substantial expansion of its national mandate into the fields of health sciences, humanities and behavioural sciences as well as the development of data management services and services that promote comparative research.

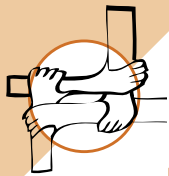
The FSD will improve its services in line with the criteria set by CESSDA. In addition to the creation of the new data portal, a number of other services and technical tools, such as the contract and licensing practices, have been upgraded. Furthermore, an extensive meta-data repository project is under way in collaboration with Statistics Finland.

Structure of the national research infrastructure

The University of Tampere coordinates the research infrastructure as part of its national mandate. The FSD is a separate unit of the university and all of its basic services are available to all user groups free of charge. The basic services were included in the national research infrastructure roadmap as early as 2009.

By the end of 2013, the archive's data catalogue contained around 1,400 datasets, most of which comprise quantitative survey data. There are almost 200 qualitative datasets, mainly in textual form. The annual rate at which the FSD accumulates datasets and its general rate of data accumulation are among the fastest of the CESSDA archives.

The FSD's current services facilitating data collection and providing access to data are used by a few thousand people annually. In early 2014, online data ordering and dissemination became possible. User identification and access control are based on electronic authentication. Based on the experiences of other countries, online dissemination will markedly increase the number of people using archived data and other FSD services.



NATIONAL RESEARCH DATA INITIATIVE (TTA) AND KDK-PAS (NATIONAL DIGITAL LIBRARY INITIATIVE – LONG-TERM PRESERVATION PROJECT), NATIONAL INFRASTRUCTURE SERVICES

Coordination: CSC – IT Center for Science Ltd

National research infrastructure

Timetable:

- **Construction phase:** 2010–14
- **Operation phase:** 2015–

Estimated cost:

- **Total cost:** 46 million euros per year for 2014–19

Websites: <http://www.csc.fi/sivut/tta>; <http://www.kdk.fi/fi/>

preservation services are in a piloting phase. KDK-PAS is currently in operation and TTA continued as an open science and research initiative (avointiede.fi, open-science.fi).

Background

The national infrastructure services – the National Research Data Initiative (TTA) and KDK-PAS (The National Digital Library's digital preservation system) – form a national research infrastructure. Most of the services provided by TTA are in operation, and the preservation services are in a piloting phase. KDK PAS is currently in operation. The infrastructure is based on the TTA and National Digital Library (KDK) projects initiated by the Ministry of Education, Science and Culture. These collaborative projects are creating a permanent, coordinated data infrastructure supporting and managing research data within the Finnish research community across all disciplines. This data infrastructure covers services for the dissemination, storage and long-term preservation of digital data (known by the Finnish acronym PAS), including a metadata catalogue and open data access platform.

Services provided by the research infrastructure

The ambition of the TTA and KDK-PAS data infrastructures are to combine distributed data management services and existing structures into a virtual environment for data management. This environment will provide basic services for efficient data management and will be based on layered service structures through which partners can link their resources and services to form a common operational research network.

Structure of national research infrastructure

These national data infrastructure services strengthen the capacity of universities, research institutes and research infrastructures, since the data infrastructure focuses on the provision of services that would otherwise be lacking and which are cost-effective when jointly provided. In this way, the data infrastructure indirectly enhances the competitiveness of Finnish research, attracts world-class researchers to Finland and enables new scholarly perspectives and innovations. Most of the services provided by TTA are in operation, and the



3.2.2 Environmental sciences

Environmental sciences research infrastructures provide a range of services and radar and measurement stations in the atmospheric sciences and ecosystem research. Five major infrastructures have been recognised within the environmental sciences. Of these, four form part of the research infrastructure consortia on the ESFRI roadmap.

The Integrated Carbon Observation System (ICOS) research infrastructure has its headquarters in and is coordinated from Finland. In addition, the FIRI Committee has identified a potential research infrastructure project that could develop into a major national research infrastructure.

RESEARCH INFRASTRUCTURES IN THE ENVIRONMENTAL SCIENCES:

[EISCAT 3D \(Finland\), ISR \(Incoherent Scatter Radar\) System](#)

[FIN-EPOS, Finnish initiative in European Plate Observing System](#)

[FINMARI, Finnish Marine Research Infrastructure](#)

[ICOS \(Finland\), Integrated Carbon Observation System](#)

[INAR RI, Integrated Atmospheric and Earth System Science Research Infrastructure](#)

Potential research infrastructures:

[oGIIR, Open Spatial Data Research](#)



EISCAT_3D (FINLAND), ISR (INCOHERENT SCATTER RADAR) SYSTEM

National coordination: Sodankylä Geophysical Observatory, University of Oulu

Host country of the ESFRI research infrastructure: Sweden

Number of participating states: 6

Timetable:

- **Preparatory phase:** 2010–16 (site preparation 2015–16)
- **Construction phase:** 2016–19 (stage 1)
- **Operation phase:** 2018– (stage 1 commissioning 2019–21)

Estimated cost:

- **Cost to Finland:** construction and commissioning phase: 5 million euros per year for 5 years, membership fees: 1 million euros per year
- **Total cost:** 132 million euros
- **Decommissioning of old system:** 15–30 million euros

Website: <http://www.eiscat.se/>; <http://www.eiscat3d.se/>

Background

The EISCAT and EISCAT_3D incoherent scatter radars measure the coupling between the space environment and atmosphere in the auroral oval and at the southern edge of the polar vortex. Located in Svalbard, Norway, Sweden and Finland, this facility is used for research into space and plasma physics, atmospheric change due to human activities and natural causes, and the effect of space weather on navigation, communications and technological systems in the Arctic region. The radar can also be used to investigate space debris and the orbital elements of satellites, to map the lunar surface and the shape of asteroids, and to develop new radar modulations and analysis.

Services provided by the research infrastructure

EISCAT_3D is a high-power radar to be built as a distributed facility in Norway, Finland and Sweden. Based on the latest technology, this set of large, phased-array antennae will function as an incoherent scatter radar providing 3-D imaging. Among other things, it will continuously provide direct measurements of winds in the upper atmosphere as vector quantities and enable continuous monitoring of space weather effects in the Arctic region. Located on several sites, the instrumentation will comprise tens of thousands of individual fixed antennae. As many as hundreds of simultaneous antenna beams will be formed, by phasing the signals of these antennae. Advanced, entirely digital signal processing and software-based radio technology will enable continuous development and flexible application

of new measurement techniques. A software-based high-power radar of this kind has never been built, and the instrumentation has been designed to markedly outperform current radars. EISCAT_3D will comprise a high-power transmitter in Norway and four receivers in Norway, Sweden and Finland. Together with the EISCAT radar (ESR, EISCAT Svalbard Radar) currently located in Svalbard, EISCAT_3D will form a next-generation research infrastructure in the Arctic region for the next 30 years.

EISCAT_3D will open up new scientific possibilities in a field in which the Finnish scientific community has long experience thanks to the current EISCAT system. EISCAT_3D will open the door to the next generation of international cooperation in research that seeks to understand the atmospheric processes of our planet. The Finnish research community has made a major contribution to the development of measurement techniques in this area and has received international recognition, since all of the world's leading incoherent scatter radars apply techniques developed in Finland. Finland is in charge of the EISCAT_3D signal processing system, under an EU-funded preparatory project. In addition, EISCAT_3D presents the opportunity to continue the development of radar measurement in cooperation with Finnish industry. Major computation and storage capacity will be required for the management, analysis and visualisation of data to be produced by EISCAT_3D. As a national actor, CSC – IT Center for Science Ltd will be involved in the design of the required solution.

Structure of national research infrastructure

The EISCAT_3D project is coordinated by the international EISCAT Scientific Association, which maintains the current EISCAT high-power radars. The incoherent scatter technique is based on the scattering of a radio signal in the ionosphere by free electrons. As such, it is the most advanced radio technique for use in the remote sensing of the upper atmosphere and near-Earth space. Using analysis of signal samples – based on mathematical inversion, which takes account of the radar technique used and incoherent scatter theory – physical parameters in the target volume such as the concentration of free electrons, the temperature, the ion mass and ion temperature, winds and the electric field can be measured from the radar signal. The current membership of EISCAT includes Sweden, Norway, Finland, the United Kingdom, Japan and China. In addition, Russia, France, Ukraine and the European Space Agency ESA have purchased EISCAT measurement time. The EU has provided support for EISCAT's technology development projects.



FIN-EPOS, FINNISH INITIATIVE IN EUROPEAN PLATE OBSERVING SYSTEM

National coordination: Institute of Seismology, University of Helsinki

Host country of the ESFRI research infrastructure: Italy

Number of participating states: 18 members + 5 associate members

Timetable:

- **Preparatory phase:** 2008–14
- **Construction phase:** 2015–20
- **Operation phase:** 2020–

Estimated cost:

- **Cost to Finland:**
 - membership fees 200,000 euros per year
 - maintenance of national observatory system 2.1 million euros per year
- **Total cost:** 2.4 million euros per year for 2014–18

Websites: <http://www.epos-eu.org/>;
<http://www.helsinki.fi/geo/seismo>

Background

EPOS is a distributed geosciences research infrastructure, formed from national measuring stations, data networks, international data centres and European headquarters engaged in the coordination of various activities. The aim of these distributed observatories is to gather information on and develop our understanding of tectonic movement and geological-geophysical processes in Europe, as well as the related natural catastrophes and other socio-economic effects.

This network-based research infrastructure integrates Europe's national geophysical observatory networks and laboratories, which are maintained by research institutes and universities. It combines national and international database and data centre resources into a compatible whole, forming a unified data system and the supporting user portal on their basis. Finland's network consists of seismological, geodetic and magnetic stations, electromagnetic probing networks and geophysical modelling and measurement laboratories. EPOS aims to establish a European-wide observation and data service and an early warning and monitoring system serving academia, public administration organisations, citizens and geo-sector companies.

Services provided by the research infrastructure

The materials to be included in the EPOS system will be free of charge and universally available. Integration and editing of data into an inter-compatible form will promote research in the solid Earth sciences throughout Europe and enhance the continent's competitiveness in science. EPOS will provide data services and

training in the use of data resources for new research projects.

International networks of seismological observatories occupy a key position in pinpointing the location of earthquakes and in the monitoring of volcanoes, underground explosions and nuclear power facilities. Magnetic observatories are used for the monitoring of changes in the magnetic field over long intervals, the calibration of local magnetic measurements and the surveillance of magnetic storms. The geodetic network serves as the backbone of global, European and national coordinate systems and GIS-based technology, provides monitoring stations for GNSS (global navigation satellite) systems, and engages in the monitoring of the Eurasian tectonic plate and its internal movements (such as isostatic uplift) and the provision of regional navigation and positioning services.

Structure of national research infrastructure

Nine partners are involved in Finland's EPOS activities, from the following universities and research institutes: the University of Helsinki, the University of Oulu, the Finnish Geodetic Institute, the Finnish Meteorological Institute, Geological Survey of Finland, the Centre for Metrology and Accreditation (MIKES) and the CSC. In collaboration with the CSC and EUDAT project, the main objective of the FIN-EPOS research infrastructure is to develop a Finnish-language login page on which users are identified and their user rights for EPOS resources are defined.

Data from Finnish observatories will be freely available and will be provided to European and worldwide data centres involved in the EPOS project. Correspondingly, Finnish universities and research institutes will be able to use data from international centres in their own research and public administration assignments. In the absence of both a national and a European portal, the use of data from various sources currently takes time.



FINMARI, FINNISH MARINE RESEARCH INFRASTRUCTURE

National coordination: Finnish Environment Institute

Host countries of ESFRI research infrastructures:

- EMBRC: Sweden
- EURO-ARGO: France

National research infrastructure

Number of participating states:

- EMBRC: 9 founding members + 8 associate members
- EURO-ARGO: 13

Timetable:

- **Construction phase:**
 - 2012–14 FINMARI
 - 2011–14 EMBRC
 - 2014–15 EURO-ARGO
- **Operation phase:**
 - 2015– FINMARI
 - 2016– EMBRC
 - 2014– EURO-ARGO
- **Other important dates:** 2014–16 EMBRC implementation phase

Estimated cost:

- **Total costs for Finland:**
 - 3.2 million euros per year
 - investment costs 140 million euros
 - EMBRC membership fee 50,000 euros per year
 - EURO-ARGO membership fee 30,000 euros per year
 - purchasing commitments 50,000 euros per year

Background

The Finnish Marine Research Infrastructure FINMARI combines the national marine research infrastructure into a unified whole. This includes Finnish research vessels and automated offshore observation platforms, as well as universities, and experimental laboratories and field stations run by research institutes. FINMARI meets the latest scientific and social challenges by creating a common research framework for marine research and the related infrastructure, as well as specifying the synergetic roles of key national actors in the development of the research infrastructure. The FINMARI research infrastructure is a nationally and internationally open platform for Finnish marine research and researcher training. As such, it covers all of the key disciplines: biology, geology, fishery research, ecology, marine chemistry and physics, geography, remote

sensing and their multidisciplinary application in developing the monitoring and protection of the marine environment. FINMARI is drawing up a long-term development plan for Finland's national research infrastructure and is linking up Finnish marine research with international research infrastructure networks, principally the processes of the ESFRI and JPI Oceans (A Joint Programming Initiative to meet the Grand Challenges regarding European Seas and Oceans). Finland is a founding member of EURO-ARGO ERIC and an associate member of the EMBRC's preparatory phase.

Services provided by the research infrastructure

FINMARI is developing an internationally unique, multidisciplinary marine research infrastructure which crosses administrative boundaries and is critical to meeting the latest research challenges. Such challenges include the experimental research and modelling of biological interactions, the impact of ocean-atmosphere interactions on climate change, links between ecological interactions and evolution, the climate impacts of changes in marine biodiversity on the ecosystem's functioning and biogeochemical cycles, applications of genomic and proteomic techniques in marine research, the spatial modelling of biodiversity and habit functions, Arctic marine ecosystems and the development of the next generation of biochemical models for Baltic Sea ecosystems. FINMARI aims to develop automated physical, chemical and bio-optic techniques and to apply them to research into marine processes.

Structure of national research infrastructure

The Finnish Environment Institute is in charge of coordinating FINMARI. FINMARI combines the complementary resources of three key universities conducting research on the Baltic Sea (the University of Helsinki, University of Turku and Åbo Akademi University), three research institutes (the Finnish Environment Institute, the Finnish Meteorological Institute and the Geological Survey of Finland) and Arctia Shipping. FINMARI is developing an open research infrastructure, whose administration is based on the recommendations of a national marine research coordination group representing three ministries (the Ministry of the Environment, the Ministry of Transport and Communications, and the Ministry of Education, Science and Culture). In addition to this steering group, the policies guiding FINMARI's activities are set by an international scientific advisory group whose membership includes a comprehensive range of expert representatives of key sectors in multidisciplinary marine and environmental research. As well as representing the Finnish marine research ESFRI projects (EMBRC, EURO-ARGO) currently in the construction phase, the FINMARI consortium is an active participant in other developing infrastructure networks in European marine research.



ICOS (FINLAND), INTEGRATED CARBON OBSERVATION SYSTEM

National coordination: University of Helsinki, Finnish Meteorological Institute and University of Eastern Finland

Host country of the ESFRI research infrastructure: Finland

Number of participating states: 15

Timetable:

- **Construction phase:** 2008–13
- **Operation phase:** 2014
- **Other important dates:** 2014 ERIC agreement

Estimated cost:

- **Cost to Finland:** 2.5 million euros per year
- **Total cost:**
 - construction phase 200 million euros
 - operation phase 40 million euros per year

Websites: <http://www.icos-infrastructure.eu/>;
<http://icos-infrastructure-transition.eu/>;
<http://www.icos-infrastructure.fi/>

Background

ICOS is a distributed European research infrastructure consisting of national measurement stations and a European top-level organisation coordinating its activities. This distributed network of measurement stations includes more than 100 atmospheric, ecosystem and marine observatories around Europe. The measurement stations measure levels of atmospheric greenhouse gases, carbon dioxide, methane and nitrous oxide, as well as the carbon and nitrogen cycle within ecosystems and ocean-atmosphere coupling. ICOS produces long-term, consistent, precise and quality-controlled observation records on greenhouse gases, meeting the needs of research, emissions management and monitoring. Combining research with education and innovation promotes the development of greenhouse gas abatement technology. The research infrastructure has the goal of understanding greenhouse gas levels and the related changes. ICOS will enable observations of regional disturbances and the ecosystem carbon and nitrogen cycle response to climate change by reducing the inaccuracies in land-atmosphere-ocean models.

Services provided by the research infrastructure

ICOS' head office is located in Finland. Finland's ICOS activities can be divided into two sub-areas: international ICOS activities and national ICOS-Finland activities. ICOS-Finland's station network consists of an internationally open research infrastructure. Around 500 researchers per year visit ICOS-Finland and make use of its resources. Finland is the lead country in the establishment of the European ICOS organisation.

Finland also participates in the activities of the thematic centre on atmospheric measurements, being in charge of instrumentation testing in northern conditions, training and the operation of the mobile quality assurance laboratory.

Structure of national research infrastructure

ICOS was on the research infrastructure roadmap for 2009. Several Finnish atmosphere and ecosystem stations have been established or upgraded to fulfil the needs of ICOS. ICOS-Finland's national operations include the maintenance of the Finnish station network and greenhouse gas measurements. Finland's observatory network includes boreal and sub-arctic measurement stations. Equipped with state-of-the-art instrumentation, SMEAR (Station for Measuring Ecosystem-Atmosphere Relations) stations and the Pallas-Sodankylä and Utö measurement station cover all key aspects of atmospheric physics, interaction between the biosphere and atmosphere, and ecophysiology. ICOS stations participate in ICOS quality assurance activities and are provided with services by ICOS centres, such as data processing, quality assurance, data storage, and training and guidance on instrumentation. ICOS has also invested in the construction of a mobile laboratory in Kumpula, Helsinki.



INAR RI, INTEGRATED ATMOSPHERIC AND EARTH SYSTEM SCIENCE RESEARCH INFRASTRUCTURE

National coordination: Faculty of Science, University of Helsinki

National research infrastructure

Timetable:

- **Construction phase:** 2009–13
- **Operation phase:** 2014–

Estimated cost:

- **Total cost:** 28 million euros per year

Website: www.atm.helsinki.fi/FCoE/index.php/infrastructures

Background

The Integrated Atmospheric and Earth System Science Research Infrastructure (INAR RI) produces multidisciplinary, detailed data on material and energy flows within ecosystems and the atmosphere. Within INAR RI, special attention is paid to study ecosystem-atmosphere interactions, a key element being aerosols. The data generated are used to investigate ecosystem and atmospheric processes and their feedback mechanisms, the development of methodologies and measurement instrumentation, and climate modelling. INAR RI includes a number of well-equipped, continuously functioning field measurement stations around Finland, and experimental atmosphere and ecological laboratories. The distribution and access to the unique datasets is provided via a tailored database and data portal.

Services provided by the research infrastructure

INAR RI provides users with access to various parts of the research infrastructure. INAR RI metadata are centrally assembled into an e-infrastructure. Through this infrastructure, they are made openly available to public authorities and for research and education on topics concerning the atmosphere, the environment, climate change, air quality and health. In addition, the INAR e-infrastructure ensures long-term storage and unified data management. INAR RI participates in the activities of several ESFRI and other international research infrastructure networks and administers the related Finnish centres: ACTRIS (Aerosols, Clouds, and Trace gases Research Infrastructure Network), ANAEE (Infrastructure for Analysis and Experimentation on Ecosystems), PEEEX (Pan-Eurasian Experiment), COOPEUS (Connecting Research Infrastructures) and ENVRI (Common Operations of Environmental Research Infrastructures). INAR RI works in close cooperation with ICOS-Finland, the Integrated Carbon Observation System. INAR measurement stations also generate data for a range of European and global measurement networks (LTER, LifeWatch, EMEP, WMO GAW, FluxNet, AERONET, SolRad-Net and EARLINET).

Structure of national research infrastructure

INAR RI functions as a distributed infrastructure that includes components from the University of Helsinki, the Finnish Meteorological Institute, the University of Eastern Finland, Tampere University of Technology, CSC – IT Center for Science and the Finnish Forest Research Institute. Key INAR RI measurement stations include four SMEAR (Station for Measuring Ecosystem Atmosphere Relations) stations in Värriö, Hyytiälä, Helsinki and Kuopio, and the Pallas-Sodankylä Global Atmospheric Watch station. These stations are continuously operational (SMEAR I in Värriö since 1991) and can be used by INAR partners and other members of the scientific community based on joint agreements. INAR develops these stations and their research and training programmes. In addition, brand new measurement stations are being built and equipped, for example in wetlands and agricultural areas, in 2014–2015. Experimental INAR laboratories, which enable analysing the phenomena observed at SMEAR stations further in controlled environment, are located in the partner universities and research institutions.

OGIIR, OPEN SPATIAL DATA RESEARCH INFRASTRUCTURE

Potential research infrastructure

Coordination site: Finnish Geodetic Institute

National research infrastructure

Timetable

- **Construction phase:** 2015–17
- **Operation phase:** 2018–

Estimated cost:

- **Total cost:** 4.14 million euros in 2014–19

Websites: www.fgi.fi; www.csc.fi; www.syke.fi; www.luonnonvarakeskus.fi; www.geoinformatics.fi

Background

Spatial data is digital data related to a certain location which describes points of interest in the environment or phenomena or events at a certain geographical site. The aim of the Open Spatial Data Research Infrastructure oGIIR is to develop a national environmental, natural resource and land use service infrastructure based on spatial data and meeting research needs. The infrastructure provides a range of reliable, comprehensive and internally consistent source materials for environmental research and development. These materials are accessible via mutually integrated data services.

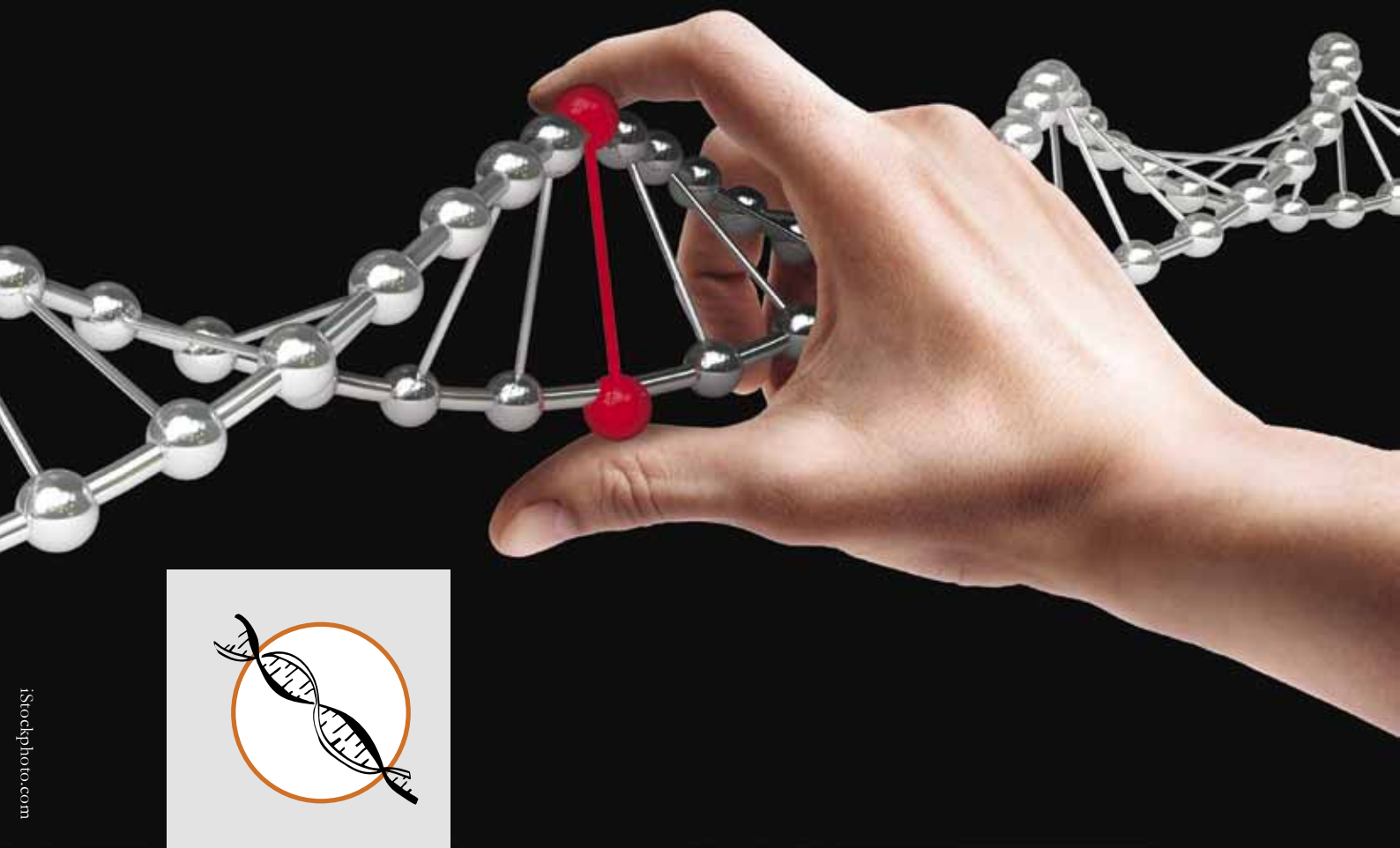


Services provided by the research infrastructure

The oGIIR infrastructure, itself a product of cooperation, serves the needs of research cooperation and information exchange with respect to spatial data, between universities and research institutes. It is based on existing spatial data, organisation-based service interfaces, the national spatial data infrastructure, and an operational network of researchers. These structures will be combined to form a virtual research infrastructure based on the principle of open accessibility, which includes storage services, spatial data packages and a metadata service. Part of this research infrastructure comprises a group of processing and analysis services used via high-powered interfaces. The infrastructure enables the storage of data produced by researchers, for later use.

Structure of national research infrastructure

The oGIIR infrastructure is coordinated by the Finnish Geodetic Institute. Collaborative bodies include Aalto University, the University of Helsinki, MTT Agrifood Research Finland, the Finnish Forest Research Institute, the University of Oulu, the Finnish Game and Fisheries Research Institute, CSC – IT Center for Science Ltd, the University of Turku and the Finnish Environment Institute. The universities participating in the construction of oGIIR are active within the Finnish University Network for Geoinformatics. The infrastructure aims to promote the use of national data



3.2.3 Bio- and health sciences

Bio- and health sciences research infrastructures have focused on providing services in areas such as biobanks, the application and exploitation of genome information, structural biology, virus technology, imaging technology in biology and medicine and translational plant research. Ten important research infrastructures were selected

for the roadmap from the bio- and health sciences. Seven of these are included in the research infrastructure consortia of the ESFRI roadmap. Of these, five consortia have established or are establishing ERIC consortia or a corresponding legal person presiding over their activities.

RESEARCH INFRASTRUCTURES FOR THE BIO- AND HEALTH SCIENCES:

[BBMRI.fi, Biobank Infrastructure](#)

[Biocenter Finland](#)

[EATRIS \(Finland\), European Infrastructure for Translational Medicine](#)

[ELIXIR \(Finland\), European Infrastructure for Biological Information](#)

[EuBI \(Finland\), European Research Infrastructure for Biomedical Imaging \(Bioimaging\)](#)

[EU-OPENSREEN \(Finland\), European Infrastructure of Open Screening Platforms for Chemical Biology](#)

[INFRAFRONTIER \(Finland\), European Research Infrastructure for the Analysis, Archival and Distribution of Genetically Modified Mice](#)

[Instruct \(Finland\), ICVIR, Integrated Structural Biology Infrastructure](#)

[NaPPI, National Plant Phenotyping Infrastructure](#)

[NVVL, National Virus Vector Laboratory](#)



BBMRI.FI, BIOBANK INFRASTRUCTURE

National coordination: National Institute for Health and Welfare (THL)

Host country of the ESFRI research infrastructure: Austria

Number of participating states: 12 founding members + 5 observers

Timetable:

- **Preparatory phase:** 2008–10
- **Construction phase:** 2011–13
- **Operation phase:** 2014–
- **Other important dates:** 2013 ERIC agreement

Estimated cost:

- **Estimated cost for Finland:** membership fee and coordination 400,000 euros per year
- **Total cost:**
 - Total costs for preparation and construction have not been estimated since THL, universities and hospital districts have collected biobank samples and data for decades
 - Academy of Finland has funded BBMRI with 3.4 million euros in 2010–13

Websites: <http://bbmri.eu/>; <http://www.biomedinfra.fi/>

Background

Biobank activities refer to the professional and uniform collection, preservation and handover of bodily samples (such as blood and tissues) and associated data from human subjects, for use in medical research and product development on the basis of principles defined in advance. BBMRI is a project on the ESFRI research infrastructure roadmap and aims to combine European biobanks to a coordinated network.

Services provided by the research infrastructure

The BBMRI.fi research infrastructure is tasked with developing collaboration between Finnish biobanks and biobank initiatives and linking biobanks to the European BBMRI-ERIC network. Participation in this process by all major Finnish biobanks will guarantee access, via the BBMRI.fi centre, to European as well as Finnish samples and data for the entire research community making use of biobank resources. The BBMRI.fi network aims to maximally utilise the existing resources and previous investments. The major goals of the BBMRI.fi network include: 1) build a national network of biobanks and serve as a link to BBMRI-ERIC; 2) promote access to clinical and population biobanks, offering tools for harmonisation of data and samples and participating in international biobank projects; 3) build a national biobank IT infrastructure serving biobanks, researchers, sample donors and authorities; 4) continue to provide infrastructure guidance and

services regarding sample collection, processing, storage and aliquoting for omics analyses and coordinate standard operating procedures and quality control; 4) provide ethical and legal services to the national biobank community; and 5) promote public awareness of the potential of biobanking in biomedical research, advancement of population health and personalised medicine. BBMRI.fi is of broad-ranging importance to basic research in the biomedical sciences, to diagnostics and to the care of individual patients. During the construction phase in 2011–2013, major achievements include the commissioning of the BBMRI.fi National Node, establishment of a biobank availability data system network as a pilot project, harmonisation of clinical and population cohort data and building and operation of a new-generation automated and integrated biobank infrastructure.

Structure of national research infrastructure

BBMRI-ERIC, of which Finland is a founding member, achieved legal validity on 3 December 2013 and started operation on 22 January 2014. In Finland, the new Biobank Act, which entered into force on 1 September 2013, enables the integration BBMRI.fi operations directly into the legal framework. The National Institute for Health and Welfare (THL) is in charge of national coordination of the infrastructure and other members of the BBMRI.fi network include all the national biobanks and national institutes engaged in establishing biobanks. The research infrastructure also acts in close cooperation with the Finnish infrastructures ELIXIR, EATRIS and Biocenter Finland.

BIOCENTER FINLAND

National coordination: University of Helsinki

National research infrastructure

Timetable:

- **Preparatory phase:** 2007, establishment of Biocenter Finland in its current form
- **Construction phase:** 2010–12, earmarked funding for restructuring and development of biosciences, from the Ministry of Education, Science and Culture
- **Operation phase:** 2010, agreement on national division of duties: provision of services for the whole of the Finnish scientific community, the private sector and internationally
- **Other important dates:** 2013, responsibility for operational funding transferred to the host universities, equipment investments brought under FIRI research infrastructure funding and university co-funding

Estimated cost:

- Total cost: 30 million euros per year for 2014–18

Website: <http://www.biocenter.fi/>



Background

Biocenter Finland (BF) is a distributed national research infrastructure. Many of its constituent elements were already selected for the 2009 national research infrastructure roadmap. BF comprises seven biocentres based at six host universities. These biocentres have combined and coordinated their resources in order to provide life sciences technology services at national level in the following areas: bioinformatics; biological imaging; genome-wide methods; model organisms; proteomics and metabolomics; stem cells and biomaterials; structural biology; translational research technologies; and viral gene transfer and cell therapy. All of these services are open to the entire scientific community and their pricing takes account of support received, in the form of funding from the host university and national competitive bids, for the purchase of equipment, the salaries of the staff who operate such equipment and other costs. All of BF's activities are regularly evaluated by an international Scientific Advisory Board (SAB).

Services provided by the research infrastructure

The objective of BF is to physically link distributed centres of expertise in partner biocentres together to form a national network that enables efficient use of resources, technology services and expertise, while minimising overlapping investments. This nationally and internationally innovative approach has already proven to be highly successful. On the basis of their research and expertise profiles, the biocentres form a mutually complementary national competency cluster. The biocentres are diverse in terms of their size, academic orientation, organisational principles and practices. They play a key role as a source of biotechnological innovation. Their state-of-the-art research infrastructures and multidisciplinary training are of major significance to product development in the private sector. BF has organised its service into 18 technology platforms covering key areas of the life sciences. These consortia, which provide technology services, include a representative from each participating biocentre and a director who is in charge of the coordination of services and training activities in practice and of infrastructure planning in line with the needs of the academic discipline in question. The SAB regularly evaluates the development plans drawn up by the technology platforms and the related funding requirements.

BF has a wide user community in Finland, comprising the country's entire life sciences community. In addition, almost all of the technology services have had customers from abroad. In researcher training within the life sciences, the teaching of methodology has been growing rapidly; the technology service consortia make a strong contribution to such work

Structure of national research infrastructure

Being fully operational, BF provides open technology services via a broad-based network. Members include Biocentrum Helsinki, the Institute of Biotechnology and the Institute for Molecular Medicine Finland within the University of Helsinki; Biocenter Kuopio at the University of Eastern Finland; Biocenter Oulu at the University of Oulu; BioMediTech at the University of Tampere; and BioCity Turku, jointly hosted by Åbo Akademi University and the University of Turku. The administrative bodies of BF comprise an assembly of the rectors of the host universities, a management group (board) and a director.

Many of BF's technology services are linked to European ESFRI roadmap infrastructures. As a result, growth is expected in international demand for BF's services and possibilities should arise for their funding from abroad. Simultaneously, Finnish researchers will be presented with the opportunity to use technology services that are unavailable in Finland.

EATRIS (Finland), EUROPEAN INFRASTRUCTURE FOR TRANSLATIONAL MEDICINE

National coordination: Institute for Molecular Medicine Finland (FIMM), University of Helsinki

Host country of the ESFRI research infrastructure: The Netherlands

Number of participating states: 10

Timetable:

- **Preparatory phase:** 2008–10
- **Construction phase:** 2010–12
- **Operation phase:** 2013–
- **Other important dates:** 2013 ERIC consortium

Estimated cost:

- **Estimated cost for Finland:**
 - membership fee 140,000 euros per year
 - coordination cost 230,000 euros per year
- **Total cost:**
 - replacement value 100 million euros
 - operational cost 3–4 million euros per year

Websites: <http://www.eatris.eu/>; <http://www.eatris.fi>



Background

Translational medicine refers to the development of new medicines, treatments and diagnostics on the basis of basic research outcomes and inventions. This European research infrastructure assists researchers and organisations, by expediting expensive and difficult translational medicine processes. As an international organisation, the EATRIS research infrastructure combines European actors in translational medicine into a network which makes its research outcomes, representing the latest technology, available to researchers, who then transform those outcomes into healthcare applications. EATRIS also provides expert services and enhances communication between researchers and physicians.

Services provided by the research infrastructure

EATRIS' operations are divided into five areas, in three of which Finland is a participant. Finland's areas of expertise are biomarkers, cell and gene therapies and radioactive marker substances and imaging. Finland is thought to benefit from its participation in EATRIS in a number of ways, such as more-effective traditional research, the strengthening of the innovation chain, better utilisation of the national research infrastructure, further progress in training and development within the discipline, the facilitation of research and development within the bio and pharmaceutical industries, and improvements in healthcare. The research infrastructure is having a major effect on biomedical research, diagnostics and the individual treatment of patients.

Structure of national research infrastructure

National coordination of EATRIS is the responsibility of the Institute for Molecular Medicine Finland within the University of Helsinki, which is also in charge of the Biomarker network. Other Finnish EATRIS participants include the University of Turku, VTT, The Turku PET Centre, the Regea Tissue Bank and Tissue Centre at the University of Tampere, and the National Virus Vector Laboratory at the University of Eastern Finland. EATRIS formed part of the 2009 research infrastructure roadmap. Finland is an active participant in the EATRIS research infrastructure. These national infrastructure services are already in operation.

ELIXIR (Finland), EUROPEAN INFRASTRUCTURE FOR BIOLOGICAL INFORMATION

National coordination: CSC – IT Center for Science Ltd

Host country of the ESFRI research infrastructure: United Kingdom

Number of participating states: 17

Timetable

- **Preparatory phase:** 2006–12
- **Construction phase:** 2012–13
- **Operation phase:** 2014–
- **Other important dates:**
 - 2013 form of ECA agreement accepted by interim board
 - 2014 establishment of first ELIXIR Nodes

Estimated cost:

- **Estimated cost for Finland:**
 - membership fee 100,000 euros per year
 - services 650,000 euros per year
 - total investments 1.43 million euros in 2014–18
- **Total cost:** 80 million euros per year

Websites: <http://www.elixir-europe.org/>;
<http://www.elixir-finland.org/>; <http://www.biomedinfra.fi/>

Background

Data generated by researchers needs to be organised, described and, above all, must be comparable with existing biological data. Based on data comparison techniques, ELIXIR's datasets can be used to identify with fast and precise methods for treating illnesses with uncertain diagnoses, such as rare hereditary diseases, and thus avoiding risky experiments. Scientific results are generated through the processing of archived datasets. Storage of data, the combination of datasets and their open distribution in Europe form the core of ELIXIR's activities.

Services provided by the research infrastructure

ELIXIR is a distributed and coordinated bioinformatics research infrastructure covering the whole of Europe. The organisation collects, maintains, stores and combines data generated and required within biotechnology. Such data relate to molecular genetic structures and behaviour within populations, and the structure and behaviour of drug ingredients and proteins. Biological, molecular-level research data and IT services designed for its utilisation will play a key role in the solution of future challenges in Europe, such as its ageing population and the environmentally friendly and sustainable production of energy and food. ELIXIR enables the application of data to healthcare and food production, for example, by



making the data freely available for further development by researchers, public authorities and firms.

Finland has established a position at the heart of ELIXIR's decision-making process. In 2010–13, ELIXIR-Finland specialised in the development, administration and provision of cloud service resources to life science organisations, biobanks and for medical research and its applications. In cooperation with FIMM, THL and national and international biology research units, CSC has succeeded in creating a new interface, Biomedinfra, for the transfer and processing of life science data. Biomedinfra helps research institutes specialise. Through the national node services, researchers can be provided with improved access to comprehensive and valuable biological data. This is achieved through cooperation with data services and the owners of datasets. Personal electronic IDs and user rights are required for this service. In Finland, such services are used by biomedical communities in particular. ELIXIR-Finland's key specialisation lies in the CSC's cloud infrastructure services for scientists, which are already operational.

Structure of national research infrastructure

A total of 17 countries have committed themselves to ELIXIR. ELIXIR has been formed from specialised, existing centres such as the European EMBL-EBI, the Swiss SIB and the Finnish CSC. The project is coordinated by the United Kingdom and ELIXIR's headquarters (ELIXIR Hub) are located in Cambridge. In Finland, ELIXIR is coordinated by the CSC, and by the Institute for Molecular Medicine Finland (FIMM/EATRIS) and the National Institute for Health and Welfare (THL/BBMRI), which also form part of the Biomedinfra consortium. Biocenter Finland is a partner of ELIXIR and a key Finnish user of its services.

EuBI (Finland), EUROPEAN RESEARCH INFRASTRUCTURE FOR BIOMEDICAL IMAGING (BIOIMAGING)

National coordination: Åbo Akademi University, University of Turku

Host country of the ESFRI research infrastructure: unknown, Germany in charge of coordinating the preparatory phase

Number of participating states: 23

Timetable:

- **Preparatory phase:** 2010–13
- **Construction phase:** 2013–17
- **Operation phase:** 2018–
- **Other important dates:**
 - 2014 participating member states sign Memorandum of Understanding (MoU)
 - 2014 Interim board established, which decides on how application process for lead centre is to be handled

Estimated cost:

- **Estimated cost for Finland:** investment need 3 million euros per year for 2014–19
- **Total cost:** 3.5 million euros per year

Websites: <http://www.eurobioimaging.eu/>;
<http://www.bioimaging.fi/>

Background

EuBI is a pan-European biological and imaging technology research infrastructure. It is tasked with coordinating the use of biomedical imaging in Europe, with the aim of maintaining Europe's leading position and competitiveness within the global research environment. In the future, the EuBI's imaging facilities will provide a full selection of high-end imaging technology, training and continuous technology development based on open access.

Services provided by the research infrastructure

EuBI-Finland is divided into three technology sectors: modern high-end microscope technologies, multimodal imaging technologies and medical imaging technologies. Through these technology sectors, almost all of the latest imaging technologies, systems and the related expertise are available to researchers in Finland and abroad on an open basis. EuBI technology sectors support and enable a wide range of basic research, pre-clinical and experimental clinical research applications for the imaging and analysis of molecules, cells, cell structures, test animals and humans.

Finland's biological and medical imaging infrastructure is among the best in Europe and is in high demand. Finland stands ready to begin providing open-access EuBI services.



Structure of national research infrastructure

The strong imaging networks of Biocenter Finland and the Finnish Bioimaging Network (FIBI) form the basis of Finland EuBI. Åbo Akademi University is in charge of the national coordination of EuBI. Other collaborating institutions include the University of Turku, Aalto University, the University of Helsinki, the Institute for Molecular Medicine Finland, the University of Eastern Finland, the University of Jyväskylä, the University of Oulu, the University of Tampere, Turku University Hospital and Helsinki University Central Hospital.

EU-OPENSOURCE (Finland), EUROPEAN INFRASTRUCTURE OF OPEN SCREENING PLATFORMS FOR CHEMICAL BIOLOGY

National coordination: Institute for Molecular Medicine Finland (FIMM), University of Helsinki

Host country of the ESFRI research infrastructure: Germany

Number of participating states: 17 + EMBL

Timetable:

- **Preparatory phase:** 2010–15
- **Construction phase:** 2015–16
- **Operation phase:** 2016–
- **Other important dates:** 2014: ERIC application scheduled to be sent to EU Commission

Estimated cost:

- **Estimated cost for Finland:**
 - membership fee 50 000 euros per year
 - national investment need 1.2 million euros in 2015–16
- **Total cost:**
 - construction phase 30 million euros
 - operation phase 12–40 million euros per year

Websites: <http://www.eu-openscreen.eu/>; <http://www.fimm.fi>; <http://www.biomedinfra.fi/>

Background

EU-OPENSOURCE, an open European infrastructure for high-capacity screening centres in chemical biology, provides the special expertise and technologies required for the development of new bioactive small-molecule compounds. The bioactive compounds discovered – tool compounds – provide the basis for the development of medicines and other bioactive substances of social and commercial importance. Additional information valuable, say, to decisions on whether to invest heavily in the development of new medicines can be

obtained by investigating the behaviour of such compounds within biological processes. In addition to a high-level research infrastructure and technologies, EU-OPENSOURCE provides users with a unique molecule library of 200 000 compounds and a related database.

Services provided by the research infrastructure

EU-OPENSOURCE's services have been designed for use in both academic and commercial research and are beneficial to all subareas of the life sciences. The bioactive small-molecule research enabled by EU-OPENSOURCE creates a basis for activities such as the development of new medicines and agrochemicals and related, commercially significant bioactive substances. In addition, the services and support provided by the infrastructure promote basic research in biology. EU-OPENSOURCE provides biologists with the opportunity to discover new bioactive small molecules that have an effect on the biological subjects of their research. It also provides chemists specialising in organic and pharmaceutical chemistry with the opportunity to explore previously unknown bioactivities of the organic compounds they have created.

The information and reagents generated by EU-OPENSOURCE will be made widely available to researchers and society in general. From Finland's perspective, EU-OPENSOURCE will make the best chemical biology facilities and special expertise available to Finnish researchers. Participation in EU-OPENSOURCE will create special expertise and jobs in Finland, as well as opportunities to develop commercial products from the scientific discoveries made.

Structure of national research infrastructure

The Institute for Molecular Medicine Finland, FIMM, under the management of the University of Helsinki, is Finland's coordinating body in this context. During the operation phase, FIMM will become one of EU-OPENSOURCE's eight High Capacity Screening Centres. A specialised screening centre has been planned at VTT. The Centre for Drug Research at University of Helsinki will host a Follow-up Assay Centre. Finally, the CSC will provide data management and data hosting support. The research infrastructure will largely utilise the same physical infrastructures as the Biocenter Finland Drug Discovery and Chemical Biology (DDCB) infrastructure platform, but will provide a new set of services and a scale of operation not available through DDCB.



INFRAFRONTIER (Finland), EUROPEAN RESEARCH INFRASTRUCTURE FOR THE ANALYSIS, ARCHIVAL AND DISTRIBUTION OF GENETICALLY MODIFIED MICE

National coordination: University of Oulu

Host country of the ESFRI research infrastructure:

Germany

Number of participating states: 12

Timetable:

- **Preparatory phase:** 2008–12
- **Operation phase:** 2013–
- **Other important dates:** 2013 establishment of Infra-frontier GmbH; Finland represented by University of Oulu

Estimated cost:

- **Estimated cost for Finland:**
 - membership fee 40,000 euros per year
 - operation phase around 500,000 euros per year
 - construction phase 1 million euros per year
- **Total cost:**
 - central office around 400,000 euros per year
 - operation phase around 80 million euros per year
 - construction phase 180 million euros

Websites: <http://www.infrafrontier.eu/>;
<http://www.fingmice.org/>

Background

Genetically modified (GM) mice are used to analyse the role and involvement of genes in human illnesses. GM mice are also important to the development of new diagnostics and treatment methods. Mouse models have also been developed and used in areas such as cancer and diabetes research. Whole genome sequencing has recently passed into general use and new gene mutations are continually being discovered connected to rare diseases. The use of model organisms is required in order to uncover the role played by observed alterations in the development and prevention of symptoms. Mouse models are also indispensable tools in such work.

The purpose of INFRAFRONTIER, the European research infrastructure for the analysis, archiving and dissemination of GM mammals, is to enable the more effective use of existing mouse models while making them easily and economically available to researchers. It also seeks to generate basic data on the characteristics of GM mice. Its activities include mouse clinics and a mouse archive. The mouse clinics perform extensive basic analyses of the characteristics of GM mice. In the mouse archive, mouse strains are stored in the form of embryos or gametes preserved in liquid nitrogen, in order to reduce the number of live animals used. Mice are supplied for research projects according to orders.

The trained staff and high-quality facilities of INFRAFRONTIER guarantee that the wellbeing of laboratory animals is properly taken care of. An important part of the operations involves the collection of data in an open database. From these data, comparisons with the symptoms of human diseases can be made; this will serve to increase the use of GM mice in applied biomedical research such as pharmaceutical testing.

Services provided by the research infrastructure

The European Mouse Mutant Archive, EMMA, functions as the mouse repository of INFRAFRONTIER. Mouse models produced by internationally funded consortia or created by individual researchers are collected in this repository. The researchers retain the rights of ownership. Cryopreservation is free of charge thanks to funding obtained from the European Union, and customers ordering the strains are charged for reagent and shipping costs. The Finnish EMMA node, the Biocenter Oulu Transgenic Core Facility, began operating in 2013. The Facility serves researchers on a national basis and supplies mouse strains stored in Finland to researchers all over the world.

With the operation of INFRAFRONTIER activities in Finland, the joint use of mouse lines of scientific value as well as the delivery of mice to partners will be more efficient. Although there are no plans to begin mouse clinic activities in Finland, Finnish researchers can send mice for mouse clinic analyses and participate in courses and meetings held within various institutes. Finnish expertise can also be utilised in further analysis of interesting mouse strains. Finland's participation in the INFRAFRONTIER research infrastructure will provide Finnish researchers with high-standard mouse analysis and repository services, expert guidance and advice and contacts with actors in the field around the world, while expediting the adoption of new research methods.

Structure of national research infrastructure

INFRAFRONTIER was included in the 2009 national research infrastructure roadmap. The University of Oulu and the Transgenic Core Facility of its research organisation, Biocenter Oulu, are in charge of INFRAFRONTIER services in Finland. The services of the core facility have been systematically developed and the related infrastructure has been built. Only upgrades of the operational environment and facilities will be necessary in the forthcoming years. Biocenter Finland, particularly the partners of its FinnMouse technology platform – Biocentrum Helsinki at the University of Helsinki, Biocenter Kuopio at the University of Eastern Finland and the Turku Center for Disease Modeling at the University of Turku are involved in the activities. NordForsk has funded the operations of the Nordic Infrastructure for Mouse Models, whose mission is to strengthen Nordic participation in the European INFRAFRONTIER project.



INSTRUCT (Finland), ICVIR, INTEGRATED STRUCTURAL BIOLOGY INFRASTRUCTURE

National coordination: Faculty of Biological and Environmental Sciences and Institute of Biotechnology, University of Helsinki

Host country of the ESFRI research infrastructure: United Kingdom

Number of participating states: 11

Timetable:

- Preparatory phase: 2008–13
- Operation phase: 2014–
- Other important dates: ERIC consortium in progress

Estimated cost:

- Estimated cost for Finland: 450,000 euros per year

Websites: <http://www.structuralbiology.eu/>;
<http://www.helsinki.fi/molecularvirology/instruct/ICVIR/index.htm>

Background

Instruct is a European research infrastructure included on the ESFRI roadmap. It makes major structural biology research facilities available to all researchers belonging to member organisations. It also expedites the development of integrated structural biology and increases the amount of molecular and atomic-level data available on cellular-level events. Instruct develops technologies and methodologies and trains experts in the solution of complex problems in structural biology.

Services provided by the research infrastructure

A total of 14 Instruct centres, selected via a process of scientific evaluation, are located in various European countries. These centres generate expertise and services, from the creation of samples to structural analysis. The centres are in charge of the development, construction and maintenance of high-cost research infrastructures. In addition, some provide important smaller-scale, more specialised research facilities and systems. Each centre reserves at least 20 per cent of its resources for use at European level. Instruct centre users are selected on the basis of scientific evaluation. Instruct will be in operation in 2014. One centre in Finland, ICVIR, has been approved. ICVIR focuses on the structural biology of viruses, particularly high-resolution structural analysis related to virus production and methodology development.

Structure of national research infrastructure

The University of Helsinki is responsible for the coordination of the ICVIR centre. Instruct already functions as an international research infrastructure, within which the ICVIR at the University of Helsinki is one of the operational Instruct centres.

NaPPI, NATIONAL PLANT PHENOTYPING INFRASTRUCTURE

National coordination: Faculty of Biological and Environmental Sciences, University of Helsinki

National research infrastructure

Timetable:

- Preparatory phase: 2014–15
- Construction phase: 2016–17
- Operation phase: 2018–

Estimated cost:

- Estimated cost for Finland: 700,000 euros per year in 2014–19

Background

NaPPI, a national plant phenotyping infrastructure, comprises a high-throughput plant phenotyping unit, imaging equipment, data management, greenhouse facilities and growth chambers (University of Helsinki) and a spectral imaging laboratory (University of Eastern Finland). It focuses on basic and translational plant research, plant breeding and plant production. Among other activities, the infrastructure enables the analysis of live plant material using high-throughput methods, data collection on plant growth, development, biomass, bioenergy and environmental responses. NaPPI combines the latest advances in plant genomics and molecular biology in translational research on plants. By improving plant productivity, food and basic raw materials can be produced in an ecological sustainable manner for the growing human population.

Services provided by the research infrastructure

Plant-based products are a key factor in fulfilling humanity's growing need for food, natural fibres, raw materials, energy and bioproducts. There is a great need for better and more sustainable forestry and agriculture. In order to achieve higher productivity and quality and for the more-effective utilisation of limited natural resources, the combination and development of translational plant research is indispensable, in everything from molecular and genetics-based approaches to fieldwork. The NaPPI research infrastructure is creating and developing an automated high-performance research platform for plant phenotyping. The aim is to generate comprehensive phenome data on a wide range of plants and to develop imaging techniques (particularly spectral imaging). This will create a framework for basic and translational plant research, plant breeding and sustainable plant production. The customers of these phenotyping services include the Finnish plant research community, commercial plant breeders and producers, and several SMEs in the environmental and bioindustry sector. NaPPI also serves plant researchers in the Nordic and Baltic countries. This phenotyping platform solves



contemporary phenotyping problems, enables high-throughput phenotyping and promotes genetic research, breeding and more efficient farming, while helping Finnish researchers to achieve and maintain their unique position at the forefront of their field.

Structure of national research infrastructure

The University of Helsinki and the University of Eastern Finland are jointly responsible for coordinating this research infrastructure. NaPPI is located on the Viikki campus at the University of Helsinki and the Joensuu campus of the University of Eastern Finland. Representatives of the University of Oulu, the University of Turku, MTT Agrifood Research Finland and the Finnish Forest Research Institute are partners in NaPPI activities. MTT and METLA will form part of the forthcoming Natural Resources Institute Finland.

This constitutes the most widely needed technology among current research communities and biotechnology companies. It will enable them to remain at the forefront of development.

Structure of national research infrastructure

The host organisation is the A.I. Virtanen Institute, which forms part of the University of Eastern Finland and is located in Kuopio. Established in 1995, the laboratory has been continuously developed to meet tightening official requirements. It forms part of ESFRI's EATRIS research infrastructure network, for which it produces viruses suitable for gene therapy, and is a key participant in projects such as the Academy of Finland's Cardiovascular Diseases and Type 2 Diabetes Research Centre of Excellence and the European Research Council's Advanced Grant programme.

NVVL, NATIONAL VIRUS VECTOR LABORATORY

National coordination: A.I. Virtanen Institute, Biocenter Kuopio, University of Eastern Finland

National research infrastructure

Timetable:

- **Established:** 1995
- **Operation phase:** in operation

Estimated cost:

- **Estimated cost for Finland:** around 1.1 million euros per year

Website:

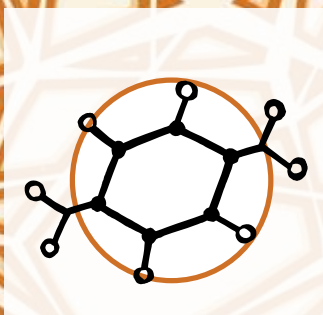
<http://www.uef.fi/fi/bck/national-virus-vector-laboratory>

Background

The National Virus Vector Laboratory (NVVL) is an internationally recognised research centre, which forms a national centralised research infrastructure. NVVL produces high-quality gene transfer vectors for pre-clinical, toxicological and clinical research. Its services, which are based on open access, are aimed at research communities and biotechnology companies in Finland, the European Union and elsewhere around the world.

Services provided by the research infrastructure

The need for high-quality gene transfer vectors has increased rapidly. In order to satisfy current national and EU official regulations, ever more advanced production techniques are needed in the development of both basic research and new clinical treatment methods. NVVL fulfils the requirements for cell banks, material handling, production and QC and QA operations. NVVL is also involved in the development of the next generation of new targeted gene transfer vectors, such as genetic vaccinations. Plans include the renewal of the bioreactor system forming part of the cultivation technology, to enable the use of adherent production cells.



3.2.4 Material sciences and analytics

Material sciences and analytics research infrastructures provide a range of services and facilities for research on and the imaging of nano-level materials, based on high-power X-ray sources, nanotechnologies and synchrotron radiation equipment.

Three major research infrastructures have been added to the roadmap. Of these, the European XFEL research infrastructure is on the ESFRI roadmap.

RESEARCH INFRASTRUCTURES FOR MATERIAL SCIENCES AND ANALYTICS:

[MAX IV Laboratory for Synchrotron Radiation Research](#)

[Otaniemi Micro- and Nanotechnology Research Infrastructure](#)

[XFEL and XBI \(Finland\), European X-ray Free-Electron Laser \(XFEL\) and its Integrated Biology Infrastructure \(XBI\)](#)



MAX IV LABORATORY FOR SYNCHROTRON RADIATION RESEARCH

National coordination: University of Oulu
Host country of research infrastructure: Sweden
Timetable:

- **Construction phase:** 2011–2020
- **Operation phase:** 2016–2041
- **Other important dates:** 2016 inauguration of infrastructure

Estimated cost:

- **Total cost:**
 - construction phase 230 million euros
 - operation phase around 40 million euros per year

Website: <https://www.maxlab.lu.se/>

Background

MAX IV is a new generation synchrotron radiation source under construction in Lund, Sweden. The international MAX IV laboratory will be the home of broad-based research in physics, chemistry, materials science, environmental sciences, bioscience and medicine. The laboratory will replace the current MAX-II and MAX-III laboratories in providing new and innovative solutions, extending the current use of the electromagnetic radiation spectrum from the ultraviolet spectrum to high-energy X-rays. When the operation phase begins in 2016, MAX IV will be the world's brightest synchrotron radiation source, up to 30 keV energies. Alongside the joint European ESRF laboratory, the facility will provide new, unique possibilities for the multidisciplinary Finnish research community.

Services provided by the research infrastructure

Synchrotron radiation is the light generated by charged particles in accelerating motion. It provides a versatile and widely used scientific instrument, opening up possibilities to conduct research that would be impossible in small, university-level laboratories. Synchrotron radiation is used worldwide in basic and applied research and industrial R&D. Typical research subjects vary from atomic, molecular and materials research in physics and chemistry to nanoparticles in atmospheric research, structural determinations of biomolecules, surface materials for the steel industry, materials in nanophotonics, macroscopic biological objects and live medical subjects.

National commitment to the MAX IV laboratory will secure opportunities for Finnish researchers to use current and forthcoming modern research techniques and tools that would be unobtainable on the basis of Finnish funding alone. This will enable the researchers to remain at the international forefront of the field. Synchrotron research centres are also excellent training

environments for young scientists, whether they are based in universities or moving into the industrial sector. Many new doctoral graduates from the Finnish synchrotron radiation user community have found employment in international synchrotron research facilities.

Structure of national research infrastructure

The construction phase of the MAX IV laboratory's accelerator infrastructure and phase one beamlines is scheduled for 2011–2016. By 2026, the facility will host 25 separate beamlines meeting a wide range of research needs. At the time this roadmap was being finalised, negotiations on the internationalisation of the laboratory were under way.

In Finland, the project is supported by the University of Helsinki, the University of Jyväskylä, the University of Oulu and the University of Turku, Tampere University of Technology, Aalto University and Åbo Akademi University. Finnish researchers have already been using the facilities at the MAX laboratory for 20 years. Finland has been participating in the construction phase of MAX IV since 2010, based on Academy of Finland funding. As part of the MAX IV project, Finland is also participating in the design and construction of the Estonian-Finnish material research beamline, FinEst-BeaMS. The scientific community associated with this project forms an international and exceptionally multidisciplinary research community specialised in the research using synchrotron radiation. Finnish researchers and companies can benefit from the MAX IV infrastructure by applying for research time either directly or in cooperation with an expert network, the FSRUO (Finnish Synchrotron Radiation Users' Organisation). In addition to basic research, Finnish research activities encompass studies in the fields of metallurgy, paper material, photonics, energy technology and innovative biodegradable and active implants, in partnership with industry.

OTANIEMI MICRO- AND NANOTECHNOLOGY RESEARCH INFRASTRUCTURE

National coordination: Aalto University

National research infrastructure

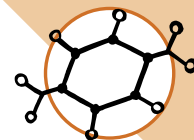
Timetable:

- **Operation phase:** in operation

Estimated cost

- **Total cost:** 11 million euros per year

Websites: <http://www.micronova.fi/>; <http://nmc.aalto.fi/en/>; <http://iti.aalto.fi/>



Background

The Otaniemi micro- and nanotechnology research infrastructure focuses on competitive research in the nanosciences and technology, and in quantum techniques. This research infrastructure offers a wide selection of production processes and equipment for micro- and nanostructures. Included is a comprehensive range of imaging and characterisation equipment, including electron microscopy, nanomicroscopy and x-ray scattering apparatus. Key activities within the research infrastructure include ultra-low-temperature conductivity and high-frequency measurements. This is a top-level learning environment for young researchers, which functions as an international centre for scientific research. By combining these scientific resources, the research infrastructure is bolstering nanoscience and nanotechnology research, training, application manufacture and entrepreneurialism in Finland.

Services provided by the research infrastructure

The Otaniemi micro- and nanotechnology research infrastructure brings together three national research infrastructures added to the 2009 national research infrastructure roadmap.

The (Cryohall of the) Low Temperature Laboratory provides a research environment for the study of low temperatures and nanoelectronics. This facility promotes scientific research and technology development in the fields of low-temperature physics, quantum electronics and cryotechnology. It provides researchers with the opportunity to conduct research below four Kelvin all the way down to record low temperatures.

Nanomicroscopy Center has a range of high-resolution microscopes such as transmission electron microscopes, Scanning Electron Microscopes, high-resolution surface imaging equipment and a versatile range of x-ray scattering equipment. These assist in activities such as imaging and research into soft and hard materials and biological samples.

The Micronova Nanofabrication Centre offers cleanroom facilities for the preparation of micro and nanosamples, quantum instrumentation, microsystem and microfluidic chips, micro and nanosensors, and photonic and optoelectronic equipment. Its operations are based on the open accessibility of its servers and collaboration between centres. Alongside other cooperation, collaborative activities and the use of equipment have been improved and made more effective on a continuous basis.

Structure of national research infrastructure

Aalto University coordinates the infrastructure, while VTT Technical Research Centre of Finland is the second-line organisation with operational responsibility. More than 30 companies are engaged in close cooperation with the research infrastructure and eight new companies have been established in the last five years. A unique, high-quality framework is enabling the development of the research infrastructure into an internationally attractive network.

XFEL AND XBI (Finland), EUROPEAN X-RAY FREE-ELECTRON LASER (XFEL) AND ITS INTEGRATED BIOLOGY INFRASTRUCTURE (XBI)

National coordination: University of Oulu

Host country of the ESFRI research infrastructure:

Germany

Number of participating states: 12

Timetable:

- **Construction phase:** 2009–17
- **Operation phase:** 2017–
- **Other important dates:**
 - 2014–17 XBI construction phase
 - preparation and commissioning of XBI simultaneously with XFEL

Estimated cost:

- **Estimated cost for Finland:**
 - cost during the XFEL construction phase: 14 million euros, operational cost 1.1 million euros per year
 - cost during the XBI construction phase: 2 million euros, operational cost 200,000 euros per year
- **Total cost:**
 - XFEL construction cost 1,400 million euros
 - XBI 21.5 million euros

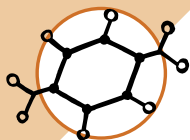
Website: <http://www.xfel.eu/>

Background

The European X-ray Free Electron Laser, XFEL, is a joint business venture by twelve European countries, involving the construction of the XFEL-based Integrated Biology Infrastructure, the XBI. The XFEL will generate ultrashort X-ray pulses based on a femtosecond construction and with a brilliance over one billion times that of modern x-ray sources. These unique features provide completely new opportunities for both research and industrial users in the fields of physics, the material sciences, the biosciences and medicine. The XFEL provides instrumentation for the imaging of nano-level materials, temporal differentiation studies of ultrafast processes and the study of small quantum systems. Using the XFEL's spectroscopy and x-ray scattering equipment, researchers can study various molecules' atomic and electron structures and dynamics, and can image biomolecules and clusters as individual particles in high energy density conditions.

Services provided by the research infrastructure

The research infrastructure XBI, to be built in conjunction with the XFEL, will be coordinated by The European Molecular Biology Laboratory (EMBL). Due to the fragility of biological samples, it is important that they can be prepared for testing, just prior to experiments, in the same facilities. On a global basis, the XBI



will provide research teams with the framework and expertise required for the preparation, analysis and measurement of samples, using the XFEL. The XFEL has the potential to have a major impact on structural biology since, based on single particles, it will enable the high-resolution imaging of large macromolecules and the related complexes, even organelles or entire cells.

Structure of national research infrastructure

The scientific community of the Faculty of Biochemistry and Molecular Medicine at the University of Oulu is responsible for coordinating this national infrastructure. Finland's membership of the XFEL/XBI infrastructure will benefit both single-discipline and multi-disciplinary research in physics, the material sciences and life sciences within Finland. It will also enable Finnish user groups to participate in the development of the research infrastructure, and the design and later use of research stations.



3.2.5 Natural sciences and technology

Natural sciences and technology infrastructures provide a versatile range of services and facilities in the fields of geophysics, material physics, astronomy and biotechnology. Four major research infrastructures were selected for the roadmap

from natural science and technology disciplines. Two of these, the Cherenkov telescope array and the Euclid cosmology mission, are included on the ESFRI roadmap.

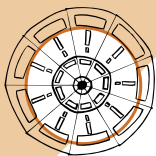
NATURAL SCIENCE AND TECHNOLOGY INFRASTRUCTURES:

[BIOECONOMY Infrastructure, Alliance for Excellence in Sustainable Biomass Refining](#)

[CTA \(Finland\), Cherenkov Telescope Array](#)

[Euclid Cosmology Mission \(Finland\)](#)

[JYFL-ACCLAB, Accelerator Laboratory of the University of Jyväskylä](#)



BIOECONOMY INFRASTRUCTURE, ALLIANCE FOR EXCELLENCE IN SUSTAINABLE BIOMASS REFINING

National coordination: Department of Biotechnology and Chemical Technology, Aalto University

National research infrastructure

Timetable

- Preparatory phase: 2013
- Construction phase: 2014–18
- Operation phase: 2019–

Estimated cost:

- Cost to Finland:
 - 14 million euros per year
 - investments 25–28 million euros in 2014–19

Background

Transformation from fossil-based economy to sustainable bioeconomy is often hindered by a lack of enabling technologies. This technology development has been recognised to be of high importance in Europe and Finland. In combining the scientific infrastructures of Aalto University and VTT Technical Research Centre of Finland, the BIOECONOMY infrastructure will enable new breakthroughs in bioeconomy technologies.

Services provided by the research infrastructure

The research focuses of the BIOECONOMY infrastructure include industrial biotechnology, chemical process technology and material technology, and a special area of expertise is processing of forest biomass into high-technology products. Research within the infrastructure transfers academic research discoveries from the molecular level through the whole development chain to innovations and novel technology concepts for bio-based products. The research infrastructure includes state-of-the-art research laboratories, characterisation and analysis equipment, modelling and simulation tools and a wide range of pilot-scale process equipment. The aim is to utilise renewable biomass in the development of biobased chemicals, fuels, materials and fibres.

The BIOECONOMY infrastructure offers an internationally unique research environment promoting bioeconomy innovations and the competitiveness and renewal of Finnish industry. The aim is to promote international research cooperation and networking.

Structure of national research infrastructure

The BIOECONOMY infrastructure is mainly located on the Otaniemi campus complemented with relevant VTT units at other locations. It is an effective collaborative tool in the coordination of research topics, new investments, and teaching enabled by the infrastructure. Future development of the BIOECONOMY

infrastructure will be made together with universities within the sector, Strategic Centres for Science, Technology and Innovation, e.g. FIBIC, other Finnish industry actors and SMEs.

CTA (Finland), CHERENKOV TELESCOPE ARRAY

National coordination: Department of Physics and Astronomy, University of Turku

Host country of the ESFRI research infrastructure: Germany

Number of participating states: 28

Timetable:

- Construction phase: 2014–19
- Operation phase: 2019–
- Other important dates: October 2014, selection of the locations for telescopes

Estimated cost:

- Cost to Finland: 650,000 euros per year
- Total cost: 200 million euros (construction phase)

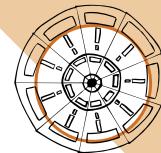
Website: <http://www.cta-observatory.org/>

Background

Cherenkov telescopes have revolutionised high-energy astronomy over the last ten years. During this period, the number of objects detected through gamma-ray astronomy, based on photons in the TeV range, has risen from six to more than 160 and new objects are continuously being discovered. The most important Cherenkov telescopes have been the European-managed MAGIC and HESS telescopes and the USA's VERITAS. These three largest telescope arrays have now decided to join forces and build a new-generation Cherenkov telescope array (CTA). The aim is to build two systems covering the entire sky, one for the southern hemisphere and the other for the northern hemisphere. Both together will include around a hundred telescopes, whose observations can be combined. This will mean a sensitivity at least an order of magnitude higher than that achievable with current equipment.

Services provided by the research infrastructure

Through the CTA, very high energy gamma-rays from around the universe are studied and images of cosmic processes are created. This is beyond the capabilities of a conventional telescope based on the visible electromagnetic spectrum. In addition, the CTA has the potential to make new discoveries in astronomy, astrophysics and physics. In investigating the origin of cosmic rays and their effects on the structure of the universe, the CTA will use gamma-ray observations to study the acceleration of galactic particles and the effect of black holes on particle acceleration, as well as



the original nature of matter, dark matter and its effects on quantum gravity.

Structure of national research infrastructure

Various research communities in Finland have been strongly involved in the CTA. Researchers from the Tuorla observatory and Metsähovi Radio Observatory were actively involved in the Compton Gamma Ray Observatory's quasar monitoring programme in 1991–2000. This work has continued through the Tuorla Observatory's participation in MAGIC collaboration, as a full member since 2002. The University of Helsinki is home to a high-energy research group focused on the study of galactic binary systems using various x-ray and other satellites. A research group based at the University of Oulu has strong high-energy astrophysics expertise in observational research, in the fields of galactic and extragalactic astronomy. As an ESFRI project, the CTA is viewed as one of the key instruments in the Strategic Plan for European Astronomy, together with E-ELT and SKA. More than 1,000 scientists from 28 countries are involved in the project.

EUCLID COSMOLOGY MISSION (Finland)

National coordination: Department of Physics, University of Helsinki

Coordinating country for ESA project: France

Number of participating states: 14

Timetable:

- **Preparatory phase:** 2012–14
- **Construction phase:** 2014–20
- **Operation phase:** 2020–

Estimated cost:

- **Cost to Finland:** 10.2 million euros in 2014–19
- **Total cost:** 820 million euros in 2014–19

Website: <http://sci.esa.int/euclid/>

Background

Euclid is the ESA's (European Space Agency) next cosmology satellite and its most important cosmology project over the next decade. The Euclid satellite and the Euclid Science Ground Segment (SGS), comprising Euclid's national data centres, form a major European research infrastructure. Its purpose is to solve the so-called dark energy problem – why the expansion of the Universe is accelerating and whether this is caused by dark energy filling space or whether it is due to a deviation in the laws of gravity from the general theory of relativity. Euclid will also study the distribution of dark matter throughout the Universe and contribute to the investigation of the nature of dark matter and the origin of the structure of the Universe. In temporal terms,

Euclid will focus on the last ten billion years of the 13.8 billion years since the Universe was born, thereby complementing ESA's previous Planck project, which focused on the early stages of the Universe.

Services provided by the research infrastructure

Euclid will generate a precise 3-D map of the Universe and of the distribution of galaxies and dark matter. Euclid is a space telescope that will take images of one-third of the sky, or more than 1.5 billion galaxies, over a period of six years, and measure more than 50 million galaxy redshifts. In addition to our understanding of cosmology and the related laws of nature, this huge amount of observational data will be of major importance to many fields in astronomy. Euclid will therefore generate an extensive amount of observational data with a major impact on cosmology and astrophysics.

Structure of national research infrastructure

As Finland's ESA partner, the University of Helsinki coordinates Finland's participation in the Euclid research infrastructure. In addition, research groups from the universities of Helsinki, Turku and Jyväskylä are involved in the project. CSC – IT Center for Science Ltd is also a participant in Finland's Euclid collaboration. As a member of the Euclid research infrastructure, Finland will participate in the Science Ground Segment (SGS) of the Euclid mission by developing data analysis methods, participating in the analysis of Euclid data and equipping one of Euclid's scientific data centres.

JYFL-ACCLAB, ACCELERATOR LABORATORY OF THE UNIVERSITY OF JYVÄSKYLÄ

National coordination: Department of Physics, University of Jyväskylä

National research infrastructure

Timetable:

- **Operation phase:** in operation

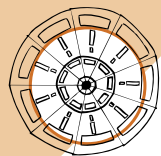
Estimated cost:

- **Cost to Finland:**
 - total operational cost 6.5 million euros per year
 - upgrade cost 5.6 million euros in 2014–19

Website: <https://www.jyu.fi/fysiikka/en/research/accelerator>

Background

JYFL-ACCLAB, the Accelerator Laboratory of the Department of Physics, University of Jyväskylä, is one of Europe's leading research facilities in nuclear physics. Its activities form part of the long-term plan of the Nuclear Physics European Collaboration Committee NuPECC, which forms part of the European Science Foundation (ESF). JYFL-ACCLAB is unique within



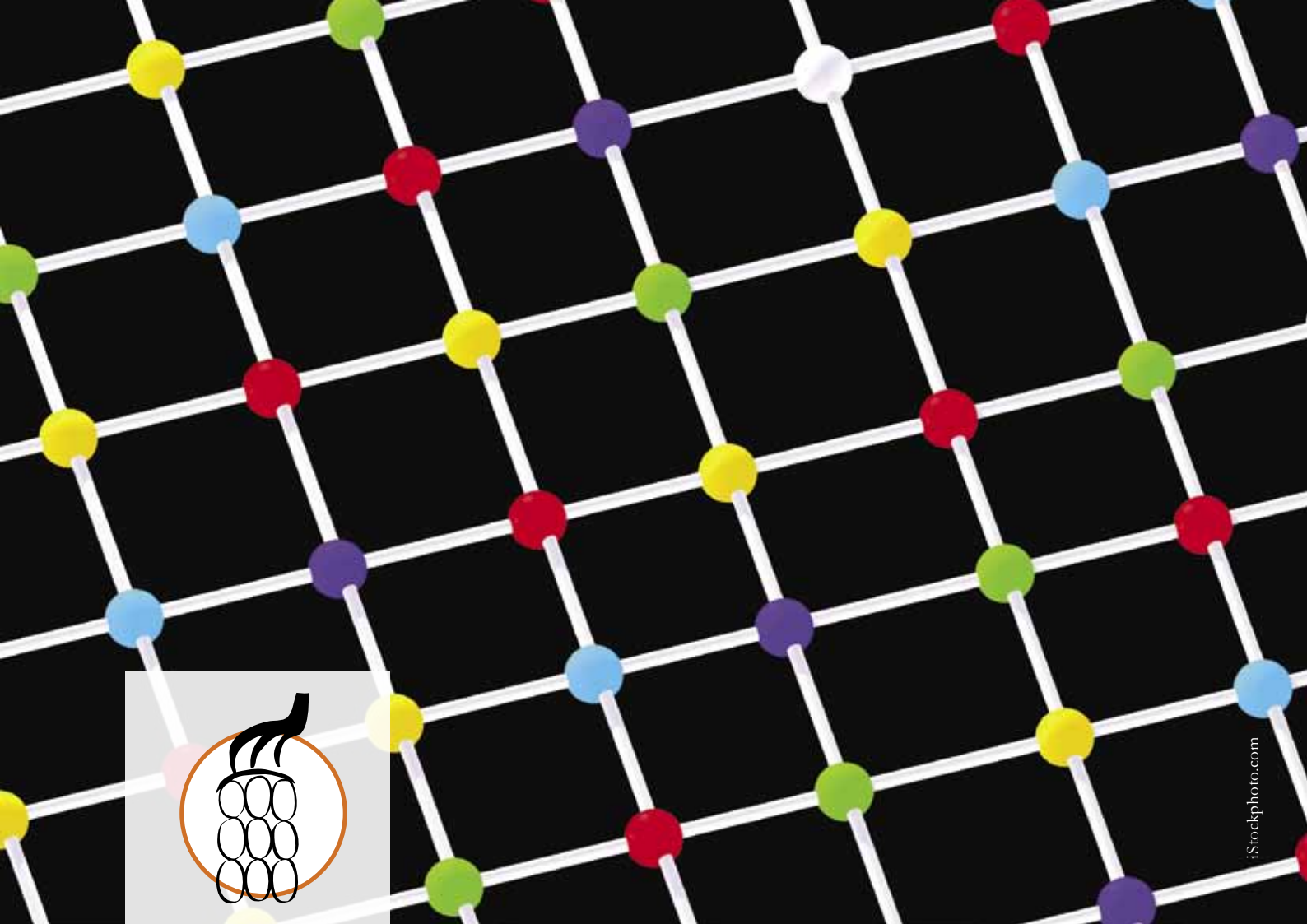
Europe in that it is firmly embedded within a host university. The research programme of the laboratory comprises projects selected on the basis of an open international application process. Decisions to include projects in the research programme are taken twice a year by a programme advisory committee consisting of international experts. In addition to basic research, applied research and commercial applications are an important part of the JYFL-ACCLAB operations.

Services provided by the research infrastructure

Ion beams of stable isotopes up to xenon are accelerated to high energies, and modern research instrumentation – most of which has been designed and built in JYFL-ACCLAB – are used as research tools. Three accelerators are in use: a $K=130\text{MeV}$ heavy-ion cyclotron equipped with two ECR ion sources, a new $K=30\text{MeV}$ high-intensity light ion cyclotron and a 1.7 MV Pelletron linear accelerator for accelerator-based applications in material physics. The online mass separator facility, IGISOL, complete with ion traps and laser equipment, and the recoil separators RITU and MARA (Mass Analysing Recoil Apparatus – currently under construction), along with the detection systems connected to them, form a fundamental part of this research instrumentation. A significant part of the instrumentation has been imported to JYFL-ACCLAB from abroad via international collaborations.

Structure of national research infrastructure

JYFL-ACCLAB functions as an EU-funded infrastructure for researchers (around 250 researchers per year) and as an accredited test laboratory the European Space Agency (ESA). JYFL-ACCLAB constitutes the Academy of Finland's Centre of Excellence in Nuclear and Accelerator Based Physics and has a national role as a centre of expertise and training in the use of accelerator technology and radiation. For example, JYFL-ACCLAB has previously been a Marie Curie Training Site. The laboratory works in close cooperation with the Helsinki Institute of Physics (HIP). In terms of the level of foreign investment, number of users and volume of scientific results, JYFL-ACCLAB is a unique international research infrastructure in Finland. The active international collaboration around the laboratory is one of the cornerstones of its activities. Such collaboration has been acknowledged in the form of funding granted under the European Framework Programmes (FP4–FP7) since 1996, the laboratory's role as Finland's main participant in the FAIR accelerator project on the ESFRI roadmap and its activities as a member of CERN's ISOLDE Radioactive Ion Beam Facility.



3.2.6 E-science and mathematics

The e-science and mathematics research infrastructures provide a range of services and supercomputers for use in computation and the management and archival of generated data, as well as open access to research results. Two major research infrastructures were selected for the e-science and mathematics

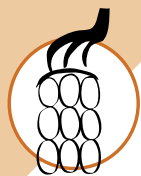
roadmap. Of the research infrastructures selected for the roadmap, PRACE is also on the ESFRI roadmap. In addition, the FIRI Committee identified a potential research infrastructure project that could develop into a major national research infrastructure.

RESEARCH INFRASTRUCTURES IN E-SCIENCE AND MATHEMATICS:

[CSC RI, IT Centre for Science – National Infrastructure](#)
[PRACE \(Finland\), Partnership for Advanced Computing in Europe](#)

Potential research infrastructures:

[FGCI, Finnish Grid and Cloud Infrastructure](#)



CSC RI, IT CENTRE FOR SCIENCE – NATIONAL INFRASTRUCTURE

National coordination: CSC – IT Center for Science Ltd
National research infrastructure

Timetable:

- **Operation phase:** in operation, CSC was founded in 1971
- **Other important dates:**
 - 1983 Finnish University and Research Network (Funet) begins operating
 - 1993 CSC becomes limited company (a non-profit state-owned limited company)
 - 2012 Datacenter CSC Kajaani begins operating

Estimated cost:

- **Total cost:** 35–50 million euros in 2014–19

Website: <http://www.csc.fi/>

Background

CSC – IT Center for Science Ltd has been providing ICT services for the Finnish scientific community since 1971. CSC is one of Northern Europe's largest supercomputing centres and is involved as a member in major European research e-infrastructures. CSC acts as a partner in several ESFRI projects and has an important role in horizontal e-infrastructures that integrate scientific disciplines and organisations across the Europe. Computational modelling and data analysis have been a fundamental part of scientific research in recent decades. The processing and management of large datasets in research is currently setting new requirements for Finland's national e-infrastructure. In addition, the importance of fast data connections is getting increasingly important as the amount of data to be processed will grow exponentially through digitalisation.

Services provided by the research infrastructure

The 2009 national research infrastructure roadmap included the Funet data network, which links Finland's universities and research institutes to CSC's supercomputer and storage platform. The modular data centre in Kajaani and the new cloud computing platform provide flexible services for research and collaboration. CSC's services such as servers, platforms, software, tools, training and expert services as well as the connections to international e-infrastructures are all at the disposal of Finnish researchers.

By continuously developing its research infrastructure, CSC cost-effectively secures up-to-date modelling and analysis services for researchers. High-quality services, state-of-the-art IT platforms and the modern Funet network create a basis for a research infrastructure that will help preserve and strengthen the high level of Finn-

ish research. At national level, CSC functions as a coordinator and intermediary in projects in which the creation of an e-infrastructure requires an impartial, reliable and experienced partner.

CSC's position as a research infrastructure serves to secure its current resources while operational development creates a basis for new resources and services for research and education. CSC's vision is to be a pioneer in the sustainable development of ICT services and to make new technology available for use in Finnish research.

Structure of national research infrastructure

CSC – IT Center for Science Ltd is a state-owned non-profit limited company administered by the Ministry of Education, Science and Culture. CSC provides IT services and resources for research, teaching, cultural and administrative needs. CSC's customers do research for example in nanosciences, astrophysics, chemistry, atmospheric science and the life sciences. CSC makes public datasets available for research in order to help researchers solve the great challenges facing humanity, such as climate change and sustainable energy production. On the other hand, it also provides a platform for the generation of new innovations.

CSC is involved in other research infrastructures as a partner, coordinator or designer. Such infrastructures include national data infrastructures (e.g. the National Research Data Initiative (ITTA) directed by the Ministry of Education, Science and Culture), the Nordic e-Infrastructure Collaboration (NeIC), the European bioinformatics infrastructure (ELIXIR), the European Data Infrastructure (EUDAT), the European Linguistic Infrastructure (CLARIN) and the Partnership for Advanced Computing in Europe (PRACE).



PRACE (FINLAND), PARTNERSHIP FOR ADVANCED COMPUTING IN EUROPE

National coordination: CSC – IT Center for Science
Research infrastructure on the ESFRI roadmap: registered in Belgium

Number of participating states: 25

Timetable:

- **Preparatory phase:** 2007–10
- **Construction and operation phase I:** 2010–15
- **Construction and operation phase II:** 2015–20
- **Operation phase:** 2020–
- **Other important dates:**
 - 2007 PRACE MoU
 - 2010 PRACE association (“legal form”, international not-for-profit association (AISBL))
 - 2015 PRACE “2.0”

Estimated cost:

- **Cost to Finland:** 0.5–3 million euros per year
- **Total cost:** 100–150 million euros per year

Website <http://www.prace-ri.eu/>

Structure of national research infrastructure

Finland is a founding member of the PRACE research infrastructure. PRACE (Finland) was included on the 2009 national research infrastructure roadmap. Under the authorisation of the Ministry of Education, Science and Culture, CSC – IT Center for Science represents Finland within the PRACE AISBL.

From the outset, CSC has played a significant role in the development of PRACE. Cooperation with PRACE enables use to be made of PRACE’s Tier-0 and Tier-1 resources in Finnish computational science research projects. Access to PRACE’s resources and participation in its other activities are of major assistance to research, the development of scientific applications and the training of computational science in Finland. Key users of PRACE supercomputer systems have included research groups from Aalto University, the University of Helsinki, the Finnish Meteorological Institute, the University of Jyväskylä, Lappeenranta University of Technology, the University of Oulu, Tampere University of Technology, the University of Tampere, VTT Technical Research Centre of Finland and Åbo Akademi University.

Background

The Partnership for Advanced Computing in Europe, PRACE, is a European research infrastructure offering high-performance computing resources. PRACE enables world-class science and research for university researchers and in private-sector product development. The PRACE research infrastructure consists of national European computing centres functioning in collaboration with one another. Established in 2010, the PRACE-AISBL is registered in Belgium and its office is located in Brussels. It has 25 member countries from EU member states and collaborating countries.

Services provided by the research infrastructure

At the moment, PRACE offers computing time on six Tier-0 and several Tier-1 national supercomputers. Its Tier-0 supercomputers are located in Germany, France, Italy and Spain. Finland’s Tier-1 supercomputer is located in Jyväskylä. Researchers from around the world can apply for PRACE resources on a competitive basis. Representatives of companies are eligible if the company headquarters or a large part of their product development is situated in Europe. A committee composed of leading European researchers evaluates applications on the basis of peer reviews. PRACE helps researchers utilise computing resources and offers a comprehensive training programme. The computing resources of PRACE are unique in the world, combining the requirements of various applications with top-level supercomputing performance.

FGCI, FINNISH GRID AND CLOUD INFRASTRUCTURE

Potential research infrastructure

National coordination: Department of Physics, University of Helsinki

National research infrastructure

Timetable:

- **Construction phase:** 2014–19

Estimated cost:

- **Total cost:** 15 million euros in 2014–19

Background

The Finnish Grid and Cloud Infrastructure FGCI is engaged in the development of a coherent grid and cloud infrastructure in Finland. Developments in computer science, physics and engineering science have enabled the development of fast computers and rapid data transfer around the world. In turn, this has led to the rapid development of scientific and commercial computing on a distributed basis over the Internet. Cloud computing and cloud services offer the possibility to use geographically distant computers and information systems in an intuitive and flexible manner, on the basis of virtual technology.



Services provided by the research infrastructure

The FGCI research infrastructure simultaneously provides powerful distributed computing capacity to all scientific sectors and for industrial collaboration, enabling use of the latest grid and cloud technologies. The FGCI will be open to all Finnish researchers. Its aim is to combine resources from different parts of Finland into a single extensive platform for tasks requiring intensive computing capacity.

Structure of national research infrastructure

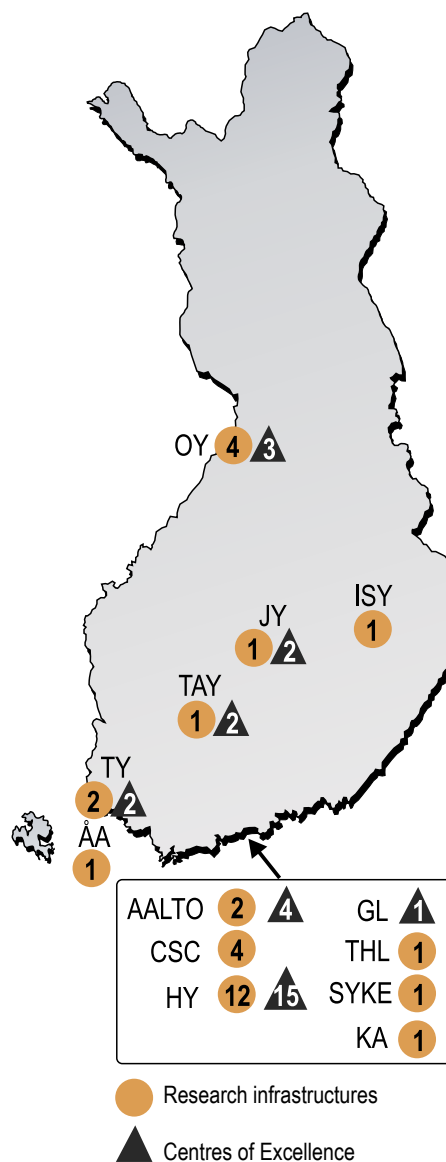
The FGCI was preceded by the Material Sciences National Grid Infrastructure M-GRID in 2005 and the Finnish Grid Infrastructure FGI, which was established in 2010. It is being built on the basis of the FGI grid services entered on the 2009 national research infrastructure roadmap. Open grid services have increased the resources available to individual researchers and the number of tasks performed through such services has grown rapidly. Computational research is attaining a major role in the development of research in general. Scientific computing has also been at the forefront of distributed grid and cloud computing.

4 RECOMMENDATIONS FOR THE DEVELOPMENT OF THE RESEARCH INFRASTRUCTURES

4.1 RESEARCH QUALITY AND RESEARCH INFRASTRUCTURES

A high-quality, state-of-the-art research infrastructure is an absolute requirement for cutting-edge research. In the evaluation of roadmap proposals, particular attention was paid to the research carried out by the applicant community and the quality of the associated project plan. Strong research clusters, such as the Academy of Finland's Centres of Excellence (CoEs) succeeded well in the evaluation. Most of the 29 CoEs active in 2014 have major actors working within research infrastructures selected to the roadmap. A total of 13 researchers from current and former CoEs are now directors of infrastructures on the 2014–2020 roadmap. One of the goals of the CoE programme includes stepping up the joint use of research infrastructures. (Figure 7.)

The expectation is that actors in a range of disciplines will network more intensively, actively forming a consensus on which research infrastructures offer a basis for high-level research, for the renewal of society and thereby for the enhancement of Finland's competitiveness and wellbeing. In addition to benefiting from collaboration opportunities, research infrastructures within the same discipline should engage in cost-effective distribution of work. Finland hosts a multifaceted research infrastructure ecosystem. However, some disciplines, such as those in the energy sector, lack organisation at both national and international level and therefore mechanisms to identify gaps should be developed.



4.2 MEASURES AND SPECIFIC RECOMMENDATIONS FOR THE DEVELOPMENT OF RESEARCH INFRASTRUCTURES

The FIRI Committee formulated a vision as part of the research infrastructure strategy:

By 2020, Finland will have gained recognition for its internationally competitive science and high-quality research infrastructures, which enable the renewal of learning, society and the business sector.

Figure 7. Host organisations of research infrastructures included in the roadmap, in relation to the coordinating organisations of the Academy of Finland's Centres of Excellence

Number of Academy of Finland Centres of Excellence active in 2014, within their coordinating universities (triangles). Number of national research infrastructures in the 2014–2020 roadmap, by host organisation (circles). Aalto university (AALTO), CSC (CSC – IT Center for Science National Infrastructure), Finnish Geodetic Institute (GL), University of Helsinki (HY), University of Jyväskylä (JY), University of Eastern Finland (ISY), The National Archives Service (KA), University of Oulu (OY), Finnish Environment Institute (SYKE), University of Tampere (TAY), National Institute for Health and Welfare (THL), University of Turku (TY), Åbo Akademi University (ÅA).

The strategy includes five sets of measures necessary to realize this vision (section 1.5.1). Specific recommendations have been included in relation to each measure.

1. Long-term development of all research infrastructures

- a. Development and maintenance plans for small, medium-sized and large research infrastructures will be included in the strategic plans of research organisations.
- b. Greater attention will be paid to the opportunities that research infrastructures provide for the renewal of the science base and business sector, the boosting of competitiveness and the further development of society.
- c. Steps will be taken to ensure that no gaps prevail within the activities of interrelated research infrastructures and that existing national research infrastructures are of a sufficiently high quality, in order to support the optimal use of international research infrastructures.

Specific recommendations for the long-term development of research infrastructures:

- The scientific community should organise itself in a manner that allows it to benefit more effectively from research infrastructures.
- Finland should increase the international collaboration and visibility of its research infrastructures. When developing international collaboration, effective use should be made of the funding opportunities available for research infrastructures from the European Union's Horizon 2020 programme.
- Finnish research organisations should make better use of Finnish membership of international research infrastructures. Efficient use should be made of international commitments and national research infrastructures in terms of researcher mobility, researcher training and the planning of research training institutions.

2. Improvements of access to and collaborative use of research infrastructures

- a. Collaboration between actors will be promoted so as to enable the realisation of the research and innovation potential provided by research infrastructures, in the development of Finnish business life and society.
- b. The collaborative use of and access to research infrastructures will be systematically promoted

between various actors, universities, research institutes, hospitals and companies, by developing collaboration mechanisms and creating new innovation ecosystems.

- c. Research infrastructure solutions that promote the creation of open science and knowledge will be developed.
- d. The utilisation rate of research infrastructures will be raised.

Specific recommendations for the development of open access and collaborative use:

- The usability and availability of national registers and material should be further developed and user costs should be lowered. Valuable material collected in Finland should be made available for wider international use by increasing the digitisation of pre-existing material, harmonising resource gathering to meet international standards and building modern metadata and web services.
- CSC's core tasks include computational science services, data network and software services, and services for the storage and use of a broad range of material. CSC's activities should also be developed to better serve research institutes and universities of applied sciences. CSC should continue research infrastructure development in collaboration with the user community and data providers.
- Improvements should be made to joint purchasing and funding mechanisms.

3. Shoring up of the funding base of research infrastructures

- a. Sufficiently long-term and effectively targeted research infrastructure funding will be secured, while acknowledging that such funding from the Academy of Finland can only cover part of the funding needs.
- b. Collaboration on research infrastructure funding with ministries, universities, research institutes, hospitals, companies and foundations will be extended.
- c. Funding systems will be rendered more clearly supportive of collaborative activities.
- d. At national and organisational level, a funding plan will be drawn up that takes into account possible changes in the lifecycle and characteristics of research infrastructures.

Specific recommendations for the strengthening of the funding base:

- Collaboration between funding bodies should be stepped up during the construction of research infrastructures. Special attention should be paid to benefiting from forms of funding provided by the European Union, such as structural funds.
- In international investments, use should also be made of in-kind contributions that promote the development of Finnish expertise and collaboration with the private sector.
- The FIRI Committee should draw up a proposal for a research infrastructure funding system and the distribution of tasks between funding bodies. In doing so, it should pay special attention to major research infrastructures spanning different organisations and administrative branches, to international research infrastructures and to potential collaboration with the business sector.
- When making preparations for collaboration on very large and expensive international projects, consideration should be given to collaborative arrangements, for example with other Nordic countries.

4. Provision of a firm basis, by the roadmap, for the methodical development of research infrastructures

- a. Major projects will be selected for the roadmap and prioritised to ensure a high level, both nationally and internationally, in terms of the renewal of the research infrastructure ecosystem, the quality of knowledge created and the impact of research infrastructures.
- b. The scope of projects selected will cover all key disciplines and support the implementation of strategies related to Finland's national science and research policy.
- c. The roadmap will enable Finland to actively influence ESFRI prioritisation.
- d. The implementation of the research infrastructure strategy and the progress of research infrastructures selected for the roadmap will be reviewed every three years.

Specific recommendations for making use of the roadmap in research infrastructure policy:

- The FIRI Committee should continue to chart the overall picture of Finnish research infrastructures, in support of science policy

decision-making and the Academy of Finland's funding decisions.

- The FIRI Committee should continue developing the prioritisation of research infrastructures via calls for funding applications.
- Prioritisation of research infrastructures and the possible existence of gaps should be reviewed regularly from the viewpoint of the national research strategy.

5. Evaluation of the impact and significance of research infrastructures

- a. The impact, significance and collaborative use of research infrastructures will be subject to regular evaluation.
- b. Decisions on the continuation of international and national research infrastructures of importance to Finland will be based on a systematic evaluation method.
- c. Evaluations will be performed of the direct or indirect benefits of national or important international research infrastructures to Finnish research, business and society. In developing such evaluations, account will be taken of the fact that the nature of research infrastructures may change due to developments in science and technology such as new digital breakthroughs.

Specific recommendations for evaluating the impact of research infrastructures:

- Research infrastructure selection criteria and expert evaluations should be applied to the development of evaluation methods and follow-up indicators.
- Once decisions have been made, the participation of researchers, industry and other actors in the activities of the research infrastructure, the use of services, and the cumulative impact of research infrastructure activities should be regularly followed up.
- On the basis of such a follow up and the evaluations, a decision should be taken on whether the activities of individual research infrastructures or decisions and agreements made on Finland's terms of participation should be reviewed. At the same time, a decision should be taken on whether to derive additional benefit from participation in possible national measures.
- Use should be made of information derived from follow-ups and evaluations in the preparation of new, corresponding projects such as the updating of the roadmap.

The FIRI Committee urges ministries, research and funding organisations and the business sector to make use of the overview, provided by the roadmap, of the national research infrastructure ecosystem and Finland's membership of international infrastructures. In addition, the FIRI Committee encourages the various actors involved to implement the recommendations made in this document.

5 APPENDICES

APPENDIX 1: FINNISH RESEARCH INFRASTRUCTURE COMMITTEE (FIRI COMMITTEE)

On the basis of the Act on the Academy of Finland (922/2009, section 2, paragraph 5), the Ministry of Education, Science and Culture ordered the Academy to establish a broad-based expert group on research infrastructures.

Academy of Finland takes note of the following aspects:

- The expert group should be sufficiently broad-based and, in addition to representatives of the Academy, should include key research infrastructure policy actors such as the Ministry of Education, Science and Culture; the Ministry of Education and Employment; Tekes – the Finnish Funding Agency for Innovation; the universities/Universities Finland UNIFI and state research institutes/the Council of Research Institute Directors. Either as members or experts, other key ministries, CSC – IT Center for Science Ltd and the Rectors' Conference of Finnish Universities of Applied Sciences should also be represented. The chair of the expert group must be broadly representative of the research infrastructure field.
- If necessary, the Academy may review the composition of the expert group.
- The Academy must consult the Ministry before establishing the expert group or engaging in a review of the group's composition.

Members of the FIRI Committee since 2012

Vice President for Research, Professor Marja Makarow, Academy of Finland (Chair 21 May 2013–, Vice Chair 30 Jan 2013–20 May 2013)

Director, Professor, Eero Vuorio, Biocenter Finland (Chair 12 Apr 2012–1 Mar 2013)

Director Riitta Maijala, Ministry of Education, Science and Culture (Member 30 Jan 2013–20 May 2013, Vice Chair 21 May 2013–)

Vice President for Research, Riitta Mustonen, Academy of Finland (Vice Chair 12 Apr 2012–29 Jan 2013)

Vice-Rector Johanna Björkroth, University of Helsinki (7 Jun 2013–31 Dec 2013)

Professor Paula Eerola, University of Helsinki, Chair of Research Council for Natural Sciences and Engineering, Academy of Finland (30 Jan 2013–)

Director Riikka Heikinheimo, Tekes – Finnish Funding Agency for Innovation (12 Apr 2012–27 Feb 2014)

Director Annu Jylhä-Pyykönen, Ministry of Education, Science and Culture (12 Apr 2012–29 Jan 2013)

Director General Lea Kauppi, Finnish Environment Institute (12 Apr 2012–)

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Vice-Rector Taina Pihlajaniemi, University of Oulu (12 Apr 2012–)

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Rector Tapio Varmola, Seinäjoki Polytechnic, the Rectors' Conference of Finnish Universities of Applied Sciences. (21 May 2013–)

Rector Thomas Wilhelmsson, University of Helsinki (12 Apr 2012–6 Jun 2013)

Permanent Expert, Senior Adviser Petteri Kauppinen, Ministry of Education, Science and Culture

APPENDIX 2: EVALUATION PROCEDURE AND INTERNATIONAL EXPERTS

Research infrastructure proposals were assessed by international evaluation panels in two stages. In the first stage, one panel selected research infrastructures on the basis of the plans of intent submitted. The principal investigators of the successful proposals were asked to submit a full proposal. The second stage involved the assessment of these proposals by eight discipline – specific international panels, which also interviewed the principal investigators.

International experts

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Professor Barthel Peter, University of Groningen, the Netherlands

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 Assistant Professor Zhao Feng, Michigan Technological University, USA
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APPENDIX 4: EVALUATION AND SELECTION CRITERIA

Appendix 4.1 Evaluation criteria for research infrastructure roadmap project proposals



Evaluation criteria for research infrastructure roadmap project proposals

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1 General evaluation criteria for a research infrastructure project

There are a set of **general criteria** for research infrastructures. A research infrastructure must:

- provide potential for world-class research and scientific breakthroughs
- be of broad national interest and enhance the international impact
- have a long-term plan for scientific goals, maintenance, financing and utilisation
- be used by several research groups/users for high-quality research
- be open and easily accessible to researchers, industry and other actors
- have a plan for access to and preservation of collected data and/or materials
- be extensive enough so that individual groups cannot manage them on their own
- introduce new cutting-edge technology (if relevant).

A research infrastructure can be national or international and single-sited, distributed or virtual.

The development of research infrastructures involves several phases, from ideas, concept development, and planning to construction and operation, to occasionally upgrading, and eventually to phasing out. These phases have different financing needs. To assure that long-term research infrastructure needs are met, different types of support and financing are necessary. From a research infrastructure perspective, relevant types of funding include:

- **planning grants** for design studies and planning of construction or collaboration
- **grants for investing in equipment or databases**, used to construct national or international research infrastructures or a single research infrastructure that is nationally accessible
- **grants for operational costs** of maintaining the operation in the long term
- **grants for phasing-out the research infrastructure** (when relevant)

A well-designed funding plan is important for the long-term design of a research infrastructure. The construction phase, mainly for centralised research infrastructures involving facilities and instrumentation, requires major, limited-time investment costs. The cost balance between construction and operation may be the opposite for distributed research infrastructures, where the greatest expense is seldom the investment cost, but rather the cost of ongoing work in standardisation, harmonisation and quality assurance of procedures and data.

Usually, research infrastructures must be upgraded to maintain their competitive strength, necessitating financing of new investments. Eventually, most research infrastructures will be phased out, which is associated with substantial costs of disassembling technical equipment and phasing out staff, etc. Hence, a phase-out plan should also be established prior to a decision to build a research infrastructure.

2 Specific evaluation criteria for research infrastructure projects

The research infrastructure projects evaluated maybe at different stages in terms of their life cycle. Some are in the planning phase while others might already be completely operational. For those research infrastructures that are in the planning phase, the evaluation is mainly based on anticipated future impacts rather than actual results. For existing research infrastructures the actual results will be evaluated.

The criteria used should be fair and equal, reflecting the international state of the art within the field in question. Major upgrades of existing research infrastructures or their reorientation require an evaluation of all criteria, the general and specific ones on pages 3 and 4-6, respectively.

The evaluation of the research infrastructure projects is carried out in a process comprising five different dimensions. Each research infrastructure project is evaluated individually in each separate dimension as well as in comparison to the other projects in all other areas of science. The dimensions are:

1. Scientific quality and potential
2. Open access and utilisation
3. Relevance to the strategies of host institutions
4. National and international relevance
5. Feasibility

2.1 Scientific quality and potential

The leading principle of evaluation is enabling scientific excellence through the research infrastructures.

Specifically, the following issues must be addressed:

1. The research infrastructure is of scientific significance and timely and provides added value at the national and/or international level
2. The research infrastructure is continuously used by excellent researchers and research groups
3. Existing research infrastructures shall provide an account of their activities, showing utilisation rate and impact, for example, in the form of scientific outputs, new applications, patents, products, or generated business activities or other societal benefits
4. The research infrastructure participates in the training of researchers or is utilised for these purposes

2.2 Open access and utilisation, Finnish and international users

Research infrastructures have developed in many different ways. The use of research infrastructures has partly grown organically over time and partly been tailored to the specific research needs. In many cases, new research infrastructures attract excellent user groups from other disciplines as well as researchers from abroad.

1. There should be open access to the research infrastructure. Access may require approval of a research plan and reasonable user fees as a compensation for the maintenance, user support and other services
2. The research infrastructure must have clear and well-functioning leadership and administrative structures, adequate personnel for the maintenance, services and user support of the research infrastructure
3. The research infrastructure should show its utilisation rate
4. The research infrastructure should demonstrate its contribution to the training of doctoral students, e.g. provision of courses and professional guidance
5. The research infrastructure should have a data management plan that consists of information on data acquisition, computation, storage, and ownership of the data. The purpose of this is to ensure future reuse of data by research community

2.3 Relevance to the strategies of host institutions

Building and operating a research infrastructure requires a long-term commitment from the research infrastructure itself and the host as well as other contributing institutions. Therefore, the strategies and priorities of the host institution(s) will also be included in the evaluation.

2.4 National and international relevance

This dimension of evaluation relates to the added value the research infrastructure provides for the national and/or international research community, and how it contributes to the visibility, attractiveness and future development of Finnish research environment.

1. Strategic significance of the research infrastructure for Finland
2. Societal impact of the research infrastructure in industrial-commercial terms or the common good either in the short (e.g. construction stage) or long term (e.g. utilisation of results)
3. Added value of the research infrastructure through international cooperation (e.g. mutual mobility) of Finnish research community

2.5 Feasibility

The feasibility of the project is assessed on the basis of the technical, institutional (e.g. form of ownership, terms of use or membership) and personnel requirements during the whole life cycle of the research infrastructure.

The expenses consist of planning, investment, operational and decommissioning costs during the whole life cycle of the research infrastructure.

Planning costs

Investment costs

- Construction/Building (incl. manpower)
- Acquisition of real estate
- Special technical equipment
- Supply/construction of devices and equipment

Operating costs

- Personnel costs (e.g. operation, maintenance, user support)
- Material costs (incl. membership fees or other payment of contributions to organisations)
- Costs of running the premises (rent, electricity)
- Other noteworthy investments (replacement purchases) required to keep the research infrastructure and equipment on an adequate level, reflecting the state-of-the-art

Decommissioning costs

- Costs of closing down the business and conservation of the resources developed

For each research infrastructure call organised by the Academy of Finland, more detailed instructions for the costs covered are given.

APPENDIX 5: ABBREVIATIONS

AALTO Aalto University
ACLC/CELC Archives and collections of linguistic corpora/Collections of electronic linguistic corpora
ACTRIS Aerosols, Clouds, and Trace gases Research InfraStructure Network
AERONET Aerosol Robotic Network
AISBL Les Associations Internationales Sans But Lucratif
AIV Vector Core
ANAE Infrastructure for Analysis and Experimentation on Ecosystems
ARENE Rectors' Conference of Finnish Universities of Applied Sciences
BBMRI Biobanking and Biomolecular Resources Research Infrastructure
BIOECONOMY Alliance for excellence in sustainable biomass refining
CERN European Organization for Nuclear Research
CESSDA Council of European Social Science Data Archives
CLARIN Common Language Resources and Technology Infrastructure
COOPEUS Connecting Research Infrastructures
COPAL Heavy Payload Long endurance Tropospheric Aircraft
CSC RI – IT Centre for Science – National Infrastructure
CTA Cherenkov Telescope Array
DARIAH Digital Research Infrastructure for the Arts and Humanities
DDCB Drug Discovery and Chemical Biology
EARLINET European Aerosol Research Lidar Network
EATRIS European Advanced Translational Research Infrastructure in Medicine
ECA ELIXIR Consortium Agreement
ECCSEL European Carbon Dioxide ND Storage Laboratory Infrastructure
ECR Electron Cyclotron Resonance
ECRIN European Clinical Research Infrastructure Network
ECORD European Consortium for Ocean Research Drilling
ECCSEL European Carbon Dioxide Capture and Storage Laboratory Infrastructure
eduGAIN Identity federation service
E-ELT European Extremely Large Telescope
EFDA-JET European Fusion Development Agreement-Joint European Torus
EISCAT, EISCAT_3D European Incoherent Scatter Facility
ELI Extreme Light Infrastructure: ultra-high-intensity short pulse laser
ELIXIR European Life Science Infrastructure for Biological Information
EMBL European Molecular Biology Laboratory
EMBRC European marine biology resources
EMEP European Monitoring and Evaluation Programme
EMFL European Magnetic Field Laboratory
EMMA the European Mouse Mutant Archive
EMSO European Multidisciplinary Seafloor Observatory
ENVRI Common Operations of Environmental Research Infrastructures
EPOS European Plate Observing System
ERIC European Research Infrastructure Consortium
ERINHA BSL4 Lab European Research Infrastructure on Highly Pathogenic Agents
ESFRI European Strategy Forum on Research Infrastructures
ESA European Space Agency
ESF European Science Foundation
ESO European Southern Observatory
ESR Eiscat Svalbard Radar
ESRF European Synchrotron Radiation Facility
ESS European Social Survey
EU European Union
EuBI Euro-BioImaging European Research Infrastructure for biomedical imaging
EUCLID the ESA's cosmological mission to study dark energy
EUDAT European Data Infrastructure
EU-OPENSREEN European Infrastructure of Open Screening Platforms for Chemical Biology
Euro-Argo Global Ocean Observing Infrastructure

EUROFEL Complementary Free Electron Lasers in the Infrared to soft X-ray range
 EU-SOLARIS European SOLAR Research Infrastructure for Concentrating Solar Power
 FAIR Facility for Antiproton and Ion Research
 FGI Finnish Grid Infrastructure for mid-range computing
 FGC I Finnish Grid and Cloud Infrastructure
 FIBI Finnish Bioimaging
 FIMM Institute for Molecular Medicine Finland
 FIMMDNA National Biobanks of Finland
 FIN-CLARIN Finnish language resources and technology infrastructure (Finland)
 FinElib National Electronic Library
 FinEstBeaMS Estonian-Finnish Beamline for Materials Science
 FinLTSER Finnish Long-Term Socio-Ecological Research Network
 FINMARI Finnish Marine Research Infrastructure
 Finna National Digital Library customer interface
 FIRI Finnish Research Infrastructure
 FIUGINET Finnish University Network for Geoinformatics
 FLUXNET Network of regional and global analysis of observations from micrometeorological tower sites
 FMAS Finnish Microdata Access Service
 FSD Finnish Social Science Data Archive
 FSRUO Finnish Synchrotron Radiation Users Organisation
 Funet Finnish University and Research Network
 GAW Global Atmosphere Watch
 GBIF Global Biodiversity Information Facility
 GL Finnish Geodetic Institute
 GNSS Global navigation satellite system
 GRID Collection of computer resources
 GWHT Genome-wide and high-throughput methods, infrastructure network
 H.E.S.S. High Energy Stereoscopic System
 HIP Helsinki Institute of Physics
 HIPER High power long pulse laser for fast ignition fusion
 HY University of Helsinki
 IAGOS In-service Aircraft for a global Observing system
 IBT BioMediTech (Institute of Biosciences and Medical Technology) at the University of Tampere
 ICDP International Continental Scientific Drilling Program
 ICOS Integrated Carbon Observation System, a network of researchers and measurement stations measuring levels of greenhouse gases
 ICT Information and communications technology
 ICVIR Instruct Centre in the field of large scale virus production and development of virus purification methods for structural analysis
 IFMIF International Fusion Materials Irradiation Facility
 IGISOL Ion Guide Isotope Separator On-Line
 IIASA International Institute for Applied Systems Analysis
 ILC-HIGRADE International Linear Collider and High Gradient Superconducting RF-Cavities
 ILL20/20 Upgrade Institut Laue-Langevin preparatory phase project
 INAR RI Integrated Atmospheric and Earth System Science Research Infrastructure
 INFRAFRONTIER European Infrastructure for Phenotyping and Archiving of Model Mammalian Genomes (for the analysis, archiving and distribution of genetically modified mice)
 Instruct Integrated Structural Biology Infrastructure
 IODP Integrated Ocean Drilling Programme
 ISBE Infrastructure for Systems Biology Europe
 ISOLDE Isotope mass Separator On-Line facility
 ISR Incoherent scatter radar
 ISY University of Eastern Finland
 ITER International Thermonuclear Experimental Reactor
 JHR MTR Jules Horowitz Materials Testing Reactor
 JYFL-ACCLAB Accelerator Laboratory of the University of Jyväskylä
 JPI Joint Programming Initiative
 JPI Oceans Joint Programming Initiative to meet Grand Challenges regarding European Seas and Oceans
 JY University of Jyväskylä

KA The National Archives Service
 KM3NET Kilometre Cube Neutrino Telescope
 KOTUS Institute for the Languages of Finland
 Lifewatch Science and Technology Infrastructure for Research on Biodiversity and Ecosystems
 LTER Long Term Ecological Research Network
 LVM Ministry of Transport and Communications
 MAGIC Gamma-ray astronomy at low energies with high sensitivity
 MARA Mass Analysing Recoil Apparatus
 Max IV, Max IV Laboratory for Synchrotron Radiation Research
 METLA Finnish Forest Research Institute
 M-GRID Material Sciences National Grid Infrastructure
 Micronova Micronova Centre for Micro- and nanotechnology, jointly run by Aalto University and VTT
 MIDRAS Micro Data Remote Access System
 MIKES Centre for metrology and accreditation
 MIRRI Microbial Resource Research Infrastructure
 MTT Agrifood Research Finland
 MYRRHA Multipurpose Hybrid Research Reactor for High-technology Applications
 NaPPI National Plant Phenotyping Infrastructure
 NARC National Archives Service of Finland
 NBA National Board of Antiquities
 NeIC Nordic e-Infrastructure Collaboration
 Neuroimaging Center for Systems Neuroimaging
 NEUTRON ESS European Spallation Source for neutron spectroscopy
 NLF Collections of the National Library
 NorIMM Nordic Infrastructure for Mouse Models
 NOT Nordic Optical Telescope
 NuPECC Nuclear Physics European Collaboration Committee
 NVVL National Virus Vector Laboratory
 OECD Organisation for Economic Cooperation and Development
 oGIIR Open spatial data research infrastructure
 OY University of Oulu
 PAS Solution for the long-term preservation of electronic materials
 PEEX Pan-Eurasian Experiment
 PET Turku PET Centre (cyclotron)
 PRACE Partnership for Advanced Computing in Europe
 Regea Tissue Bank and Tissue Centre at the University of Tampere
 ReTki Centre for Register Research
 RITU Recoil Ion Transport Unit
 SCOAP3 Sponsoring Consortium for Open Access Publishing and Particle Physics
 SGS Science Ground Segment
 SHARE Survey of Health, Ageing and Retirement
 SHOK Strategic Centres for Science, Technology and Innovation
 SIB Swiss Institute of Bioinformatics
 SIOS Svalbard Integrated Arctic Earth Observing System
 SKA Square Kilometre Array
 SLHC Preparatory phase for the Large Hadron Collider Upgrade (CERN)
 SMEAR Stations for Measuring Forest Ecosystem-Atmosphere relationships
 SolRad-Net Solar Radiation Network
 SPIRAL2 Système de Production d'Ions Radioactifs en Ligne - generation 2
 SYKE Finnish Environment Institute
 TAY University of Tampere
 Tekes Finnish Funding Agency for Innovation
 THL National Institute for Health and Welfare
 TIARA Test Infrastructure and Accelerator Research Area
 TSV Federation of Finnish Learned Societies
 TTA and KDK-PAS the National Research Data Initiative and The National Digital Library's digital preservation system
 TTP Bank of Finnish Terminology in Arts and Sciences (BFT)
 TUNE Council of Research Institute Directors

TY University of Turku
UNIFI Universities Finland UNIFI
VERITAS Very Energetic Radiation Imaging Telescope Array System
Windscanner European Wind Scanner Facility
WMO World Meteorological Organization
VTT Technical Research Centre of Finland
XBI European X-ray Free-Electron Laser (XFEL) and its Integrated Biology Infrastructure (XBI)
XFEL European X-ray Free-Electron Laser
ÅA Åbo Akademi University

APPENDIX 6: REFERENCES

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The Academy of Finland also provides funding for the establishment or upgrading of nationally significant research infrastructures that promote scientific research and innovation activities. The task of the Finnish Research Infrastructure Committee (FIRI Committee) is to develop Finland's research infrastructure policy, to update the strategy and roadmaps concerning research infrastructures and to administer the funds allocated to research infrastructure funding.



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