

**Survey & Roadmap for Research Infrastructures
in Finland**

**Report of the Physical Sciences, e-Science and Engineering
Assessment Panel**

**October 3
2008**

Contents

Foreword

EXECUTIVE SUMMARY AND RECOMMENDATIONS

1. METHODOLOGY

- 1.1. Introduction
- 1.2. Criteria and guidelines for evaluations
- 1.3. Proposal submission and steps in assessments

2. RESULTS OF THE EVALUATIONS

- 2.1. Existing Research Infrastructures
- 2.2. New Research Infrastructures
- 2.3. Research Infrastructures, decision pending
- 2.4. Technological Infrastructures

3. LESSONS LEARNED

Foreword

Three expert Panels were invited to evaluate the proposals for the first Finnish Roadmap of research infrastructures (RI) and survey of existing research infrastructures. The Panels covered Physical Sciences, e-Science and Engineering (PSE), Life Sciences & Medicine and Environmental Sciences (LME) and Social Sciences and Humanities (SSH).

In accordance with its mandate, the PSE Panel gave an overall view of the process of developing a Roadmap and a survey of national level research infrastructures. PSE assessed 51 proposals for new RIs, upgrades of RIs, and for Finnish participation in international research infrastructures or existing RI proposals.

The infrastructures under consideration cover very different types, lifetimes and costs. The PSE Panel agreed that seven proposals of high quality for research infrastructures meet the scientific and maturity criteria for inclusion on the first Finnish Roadmap and thirteen proposals meet the criteria to be listed as existing RIs. Total 14 proposals were evaluated in parallel by PSE and other Panels.

The Panel noted a few proposals as being interesting as technological infrastructures with the specific aim of industrial innovation and competitiveness.

The chair would like to express his appreciation to all members of the Panel. They contributed their time and effort during the process in ensuring the quality of the evaluations, and in providing valuable information and views to the report. Our task was facilitated by the excellent preparation, both of the material and the meeting, by the secretariat, and by the generous hospitality of our hosts.

Rainer Koepke
PSE Panel Chair

EXECUTIVE SUMMARY AND RECOMMENDATIONS

This document is the Report of the PSE Panel recommending new or upgraded Finnish Research Infrastructures (RIs), to be included in the first Roadmap of national level research Infrastructures or to be listed as existing research infrastructures in Finland. The infrastructures under consideration cover very different types, lifetimes and costs.

1. The PSE Panel faced a challenging task. We received many proposals from research institutions in Finland, which we considered to be of very high scientific value and which showed the high standard of scientific research in this country. Our primary task was to evaluate them under the criteria of research infrastructures and assess whether they fulfilled these criteria. Not being on our list of existing or proposed research infrastructures is therefore in no way an assessment of the scientific value of the proposal in itself. Such an assessment would have led to a significantly longer list.
2. In various fields of science large research infrastructures play an important role. Due to rapid technological development, the size and complexity of these infrastructures and the cost to build and operate them have increased steeply. In an increasing number of cases it is only possible to finance, build and operate them effectively on a national or international scale and not as a facility of an institute or a university alone. Such infrastructures should be open for all scientists based on the scientific merit of their research proposals, as judged by independent review.
The organization running an infrastructure is expected to give support to its external users and should be willing to accept such service tasks for external users in addition to its in-house research activity. We observed that this has not been achieved in many of the proposals reviewed but there is a tendency to develop in this direction.
3. Research infrastructures do not have value in their own right, but they are a means to support major long term scientific visions or strategies. Therefore a scientific community should discuss its future perspective and from this derive the need to construct national research infrastructure or to participate in international ones. Therefore proposals should have a basis in the scientific community of potential users and not be in the interest of an institute alone. Due to the high investments and long lifetime of large scale facilities, decisions should be based on a broad discussion within the science community and between them and the funding agencies.

In some research areas, where several proposals were submitted, we had difficulties in gaining a clear view of the outlook of the associated Finnish science communities, although we became convinced that there is a need to support related infrastructure activities. Therefore we set a mark on the Roadmap for these areas. We recommend that there

should be a comprehensive view of the perspectives of the respective fields first followed by proposals for Roadmap projects later, without re-opening the whole Roadmap activity.

- Astronomy. Finland has become a member of ESO. We expected that this would have had a major impact on the astronomy activities in Finland in order to make best use of the new opportunities. The proposals we received delivered good arguments for the continuation of existing facilities and the construction of a new radio telescope in Finland. The proposals did not allow us to derive priorities for the future development of Finnish astronomy. We therefore recommend that a shared vision of the perspectives of both optical and radio astronomy in Finland must be formulated by the astronomy community before taking decisions.
- Environment and atmospheric sciences. We received very valuable proposals in this area; we believe more momentum could be gained if these activities would be part of a single coordinated research plan. In this area, too, we therefore recommend to bring the proposers together and develop a joint view of the activities in the field.
- E-infrastructure. There is no doubt that there is a need for this kind of research infrastructure and that CSC is the main actor in Finland. However, we received several proposals which did not allow us to get a complete picture. We suggest that CSC together with the scientific users develop a coherent strategy for the future of e-infrastructure for Finland.
- Synchrotron radiation. Finland (as member of the Nordsync consortium) is a partner in the ESRF in Grenoble and should make the best use of this opportunity. In addition there are strong and established relations to MAX Lab in Sweden. Finnish scientists want to participate in the upgrade of both facilities. While we support both activities we recommend that it is necessary to develop an overall perspective for the optimal use of the resources in this area.

4. Today no country can have all research infrastructures on its own soil. Especially for a country like Finland with mostly small research communities it is necessary to participate in international institutions to secure for its researchers access to world leading facilities. The highly competitive peer review at such facilities helps to ensure high quality of research in general.

Internationally competitive research infrastructures offer excellent possibilities for higher education and the training of PhDs. The competitive peer review system is an accepted measure of high quality research. Due to the mostly cooperative projects young people learn to work in – often international – teams and on technologically challenging projects. We strongly recommend supporting especially the participation of young people in the use of first class research infrastructures.

5. To make best use of the participation in international institutions it is important to have a strong home base to ensure ownership of the science activities in the infrastructure. This ownership implies devoting human resources, especially the allocation of PhD positions, and providing resources to cope with the technologically challenging tasks for data analysis and for the development of instrumentation and of new experimental methods. Such measures should assure good relations between the home institution and the infrastructure. Particular emphasis is required in ensuring young researchers have tenure in order to allow for the long time constants in working in large research infrastructures.
6. The PSE Panel received some proposals which we considered to be very important infrastructures for the technical competitiveness of the Finnish economy. We recommend establishing a list of technological infrastructures, which have slightly different goals and should be assessed with different criteria than research infrastructures.
7. Recommendations to the government of Finland
- There is an excellent multi-faceted research base in Finland. The Panel welcomes the effort to make best use of this basis by a systematic process with external review of research infrastructure proposals.
 - In order for this process to have an impact there is a need for longer term stable funding for research infrastructures and a systematic process to establish strategies and priorities for research areas in collaboration with the research communities.
 - Decisions on major new investment should only be made after a comparative analysis of the opportunities available, and avoiding ad hoc decisions as far as possible.
 - Stable government funding for such long term investments would allow government, universities and research institutions to adapt their planning accordingly.
 - Budgets for operation should also be made available on a multi-annual basis with regular peer review.

1. METHODOLOGY

1.1. Introduction

Panel

The work for the first Research Infrastructure (RI) Roadmap to be prepared in Finland was done in three Expert Panels PSE, SSH and LME (Physical Sciences, e-Science and Engineering, Social Sciences and Humanities; and Life Sciences & Medicine and Environmental Sciences Science).

The composition of the three Panels was decided by The Steering Group of the Finnish Research Infrastructure Survey and Roadmap Project (hereafter the Steering Group). The membership of the Panels consists of both science policy and scientific experts

PSE Panel members:

Ms. Kerstin Eliasson

The Swedish Ministry of Education and Research, Sweden

Dr. Kari-Pekka Estola

Finland

Dr. Rainer Koepke (*chairperson*)

Federal Ministry of Education and Research, Germany

Prof. Poul Erik Lindelof

Niels Bohr Institute, University of Copenhagen, Denmark

Rektor Prof. Ove Poulsen (*vice chairperson*)

Engineering College of Århus, Denmark

Prof. Dany Vandromme

Ministry of Higher Education and Research, France

Prof. John Womersley

Science and Technology Facilities Council, UK

Secretariat

Eeva Ikonen

Katri Mäkinen

Marjut Nyman

1.2. Criteria and guidelines for evaluations

The working methods for Panels in the process were prepared in summer 2008 by the Steering Group. Every proposal was evaluated following the general guidelines (Terms of Reference, ToR), introduced by the Steering Group.

Conflicts of interests were declared at the beginning of the Panel meetings:

Rainer Koepke: proposal number R97;

Kari-Pekka Estola: proposals number 106, 124, 170, 171, R95, R102, R106, R107, R109, and R121.

These members took no part in the discussion of the proposals concerned.

The definition of research infrastructure

Research infrastructures (hereafter infrastructures) are resources of research methods, equipment, materials and services facilitating research and development in various stages of innovation and maintaining and developing research capacity.

Examples of infrastructures are large-scale entities of research equipment, research and measurement stations, research vessels, specialized laboratories, collections and databases of research materials, data communication networks for research purposes, archives, libraries and high-performance computing centres, as well as the opportunities of research institutions for large-scale field tests and monitoring. The concept of infrastructure also includes its upkeep and maintenance and support services offered to users.

The optimum structure of a research infrastructure naturally depends on the field of research and the user community, and their needs.

A single-sited research infrastructure is appropriate in fields that require major investments in expensive research equipment (e.g. synchrotron light sources, research reactors), special

laboratories (e.g. cleanrooms) or research materials (e.g. hazardous chemicals). Single-sited infrastructures may include satellite units or may permit remote use.

A *distributed research infrastructure* is suited to fields in which the available resources are geographically dispersed (e.g. meteorological observation networks, biobanks etc.). A distributed infrastructure may also produce shared, centralized services.

Virtual research infrastructures are, for example, databanks, archives etc. that can be accessed and used by researchers from their own workstations.

The Panels applied strict selection criteria and used standard evaluation forms in order to identify existing national RIs and mature proposals for the Roadmap. The following main criteria were used in the evaluations: scientific relevance; management to ensure the correct developments, technical adequacy, business and financial aspects, including institutional commitment; and the scale of RI (global, European or national).

1.3. Proposal submission and steps in assessments

The call for national RIs and Roadmap proposals was opened on the internet during April 2008. The proposals were sent to the PSE Panel members in July 2008. In total, the PSE Panel evaluated 51 proposals out of the total of 306 proposals that were submitted by Finnish universities, research institutes and scientific communities. 19 (+7 jointly with other Panels) of the proposals were Roadmap proposals concerning upgrading or building new national level RIs in the future (Table 1).

Table 1. Roadmap proposals evaluated by the PSE Panel (participation in international RIs indicated by gray shading).

Number	Acronym	Title
R94	NCF	Nano Centre Finland
R95	JHR MTR (ESFRI)	Jules Horowitz Materials Testing Reactor
R96	E-ELT (ESFRI)	European Extremely Large Telescope
R97	FAIR (ESFRI)	Facility for antiproton and ion research
R99	MAX IV	MAX IV
R100	ESRF-Upgrade (ESFRI)	ESRF Upgrade
R102	OtaForMa	Otaniemi Forest materials Research infrastructure
R103	JYFL-ACCLAB-UpGrade	Upgrade the Accelerator Laboratory JFL
R104	BIOMATINFRA	Infrastructure of processing biomaterials

R106	Funet2030 (CSC)	Funet Roadmap to the next decades
R107	FGI (CSC)	Finnish Grid Infrastructure for mid-range computing
R109	eSCI (CSC)	e-Infrastructure supporting e-Science
R113	FIGL	Finnish Geosciences Laboratory
R116	TKK-Skyvan	The airborne remote sensing platform of TKK
R118	CRYOHALL	Upgrade of cryohall
R119	MRO-2	Building Finnish Radio Astronomy's Future
R120	METSRI	Metsähovi Fundamental Station
R121	Micronova	Micronova Centre for Micro- and Nanotechnology
R128	EISCAT_3D	European next generation Incoherent Scatter Radar

In July 2008 the PSE Panel also received in total ten (+7 jointly with other Panels) proposals for the existing national level research infrastructures through the Steering Group (Table 2). Tables 3 and 4 list the proposals evaluated jointly with other Panels.

Table 2. Existing research infrastructure proposals evaluated by PSE Panel (participation in international RIs indicated by gray shading).

Number	Acronym	Title
77	METS	Metsähovi Fundamental Station
78	MRO	Metsähovi Radio Observatory
81	CRYOHALL	Cryohall of the Low Temperature Laboratory
83	JYFL-ACCLAB	Accelerator Laboratory of the Department of Physics
84	TO	Tuorla Observatory
88	MAX-lab	MAX Synchrotron Radiation Facility
104	CentekLabs	CentekLabs
105	LLPC	Lappeenranta Laser Processing Centre
106	Micronova	Micronova, Centre for Micro-and Nanotechnology
124	RELIEFI	Reactors lifetime management of Finland

Table 3. Proposals for the list of existing research infrastructures evaluated by PSE Panel jointly with other Panels.

Number	Existing RI	Existing RI proposal
170	CSC-Funet(CSC)	Funet (Finnish University and Research Network)
171	CSC-Services(CSC)	IT Services for Science at CSC
172	Pallas-Sod(LTSER)	Pallas-Sodankylä Super Site
174	STUK	STUK-Radiation and Nuclear Safety Authority
175	NCF	NanoCenter Finland
176	NMI	National Metrology Institute
178	MTT Experimental	Agrifood Research Experimental Centre

Table 4. Roadmap proposals evaluated jointly by the PSE Panel and other Panels.

Number	Acronym	Title
R27	Statistics	Statistics Finland's research services (upgrade)
R33	COPAL (ESFRI)	COmmunity heavy-PAYload Long endurance Instrumented Aircraft for Tropospheric Research in Environmental and Geo-Sciences
R34	EINAR	European Institute for Atmospheric Research (EINAR)
R35	ICOS (ESFRI)	Integrated Carbon Observation System
R38	SMEAR	SMEAR Stations
R39	ELIXIR (CSC) (ESFRI)	European Life Science Infrastructure for Biological Information
R41	GBRN	Demonstration project for global biological resource centre's network

Nine proposals concerned Finnish commitments or agreements in existing international research infrastructures (Table 5).

Table 5. Proposals for the list of existing international research infrastructures commitments noted by PSE Panel.

Number	Acronym	Title
88	MAX-lab	MAX Synchrotron Radiation Facility
91	ESRF	European Synchrotron Radiation Facility
93	ESA	European Space Agency
94	ESO	European Southern Observatory
95	CERN	European Organization for Nuclear Research
96	NOT	Nordic Optical Telescope
97	EISCAT	European Incoherent Scattering Association
98	JET	EFDA JET - Joint European Torus
99	ITER	ITER

The Panels used three forms to help the members to focus on the most important criteria in their evaluation. All members of Panels were asked to give a primary opinion on each proposal in written format based on existing material submitted by the coordinators through the Secretariat. In addition, one to two rapporteurs were nominated for each proposal from the PSE Panel to introduce the proposal in Panel discussions. The rapporteur collected and reported the results of these evaluations for the consensus report of the Panel.

Regarding the proposals which were sent also to other Panels for evaluation in addition to the PSE Panel, the chairs of the LME and PSE Panels exchanged their views concerning the proposals. Additionally, all the Panels' evaluation forms and consensus reports were made available to the chairs of other Panels in the panels' intranet. The LME and SSH Panel chairs as well as the LME and PSE Panel chairs had meeting together with each other before the their own meetings with Panel members.

Steps in detail

1) Every member of the Panel read all the proposals and filled in the form for a Preliminary Summary of the evaluation of each proposal. Every member made his/her first opinion of each of the proposals based on existing material. The Roadmap proposals were given grade: Mature (M), Emerging (E) or Out of scope (O), based on the initial evaluation. The proposals for the existing national RIs were evaluated according to whether they fulfilled the criteria for a national level RI or not.

The scale of the RI proposals was also evaluated:

Global = proposal has a clear global dimension

European = proposal has a pan-European nature

National = proposal has a national dimension

Local = proposal has a local dimension

The Federation of Finnish Learned Societies (TSV) established a site as a working platform for all three expert Panels. All members received a username and password to the site. The Secretariat for the Panel took care of posting documents on the site. All documents were available for all Panel members on the TSV site with the understanding that the discussions in the meeting were confidential.

2) Hearings

The PSE Panel had a meeting in Helsinki 9.-11.9.2008. The Panel invited the coordinators of 17 proposals to hearings on 9th September 2008 in Espoo (Table 6). The aim of the hearings was to get clarifications of arguments in the applications, and to answer open questions from the proposal templates.

3) Panel meetings

After the hearings, the nominated Rapporteurs gave a presentation of each proposal based on the results of the preliminary evaluation and started the Panel discussion. The panel discussed all the proposals, decided on the Roadmap proposals, and identified the national level research infrastructures in closed sessions.

The secretariat provided assistance for the Panels during their work and took notes of the meetings.

Table 6. List of the proposals invited to the hearings, E= proposal for Existing RI list, R= proposal for RI Roadmap, (participation in international RIs with shading).

Number	Title	Acronym	Hearing group
E170	Funet (Finnish university and research network)	CSC Funet	Group: e-science
E171	IT Services for Science at CSC	CSC Services	Group: e-science
R106	Funet Roadmap to the next decades	Funet2030 CSC	Group: e-science
R107	Finnish Grid Infrastructure for mid-range computing	FGI	Group: e-science
R109	e-infrastructure supporting e-science	CSC	Group: e-science
E106	Micronova, Centre for Micro- and Nanotechnology	eSCI, CSC Micronova	Group: nanoscience & nanotech
E175	Nanocenter Finland	NCF	Group: nanoscience & nanotech
R 94	NanoCenter Finland	NCF	Group: nanoscience & nanotech
R121	Micronova	Micronova	Group: nanoscience & nanotech
E94	European Southern Observatory	ESO	Group: Astronomy
E96	Nordic Optical Telescope	NOT	Group: Astronomy
E84	Tuorla Observatory	TO	Group: Astronomy
R96	European Extremely Large Telescope	E-ELT	Group: Astronomy
E77	Metsähovi Fundamental Station	METS	Group: Astronomy
E78	Metsähovi Radio Observatory	MRO	Group: Astronomy
R119	Building Finnish Radioastronomy	MRO-2	Group: Astronomy
R120	Metsähovi Fundamental Station	METSRI	Group: Astronomy

4) The final consensus evaluation reports for each proposal was made by the nominated rapporteur for that proposal. These consensus reports were aimed to be informative and analytical for future reference. The Panelists approved the consensus reports and the Panel report through written procedures using the protected web site for the Panel work.

2. RESULTS OF THE EVALUATIONS

The PSE-Panel was given the task of examining existing infrastructures, proposals for upgrading existing infrastructures and constructing new infrastructures for physical sciences, e-science and engineering in Finland. After judging whether the proposal complied with the definition of a research infrastructure, the main criterion for recommendation for the national Roadmap was a strong science and technical case, taking into account competitiveness on a European and in some cases on a global scale. In addition, the financial demands in comparison with the situation and size of the Finnish research community were considered. Several proposals were based on an existing tradition of collaborative projects and cooperation on a national or international level in the respective research community, which favoured their recognition as a national level RI. Only a few of the proposals were sufficiently focused to contribute to the advancement of multidisciplinary research, or to tackle the study of complex systems.

Evaluation of all proposals was made from a consistent point of view agreed within the PSE Panel. Many proposals were rejected because of having too narrow a scientific scope or being of only local importance, mostly at the university department level. Some proposals were considered more like networks than infrastructures and therefore did not deserve consideration as RI. Another serious problem for insufficiently mature proposals was that they did not show a coherent management structure.

The PSE Panel identified thirteen projects for the list of existing RI, of which nine are international or regional Nordic cooperative infrastructures. Seven projects should be introduced to the national level Roadmap of which 5 are mentioned in the ESFRI Roadmap. In addition the Panel expects further projects for the Roadmap from the areas mentioned in the general recommendations (paragraph 3 of the Executive Summary).

2.1. Existing Research Infrastructures

The PSE Panel examined the proposals for existing infrastructures and suggests those listed in Table 7 to be accepted as research infrastructures using the agreed definition.

Table 7. Proposals suggested to be introduced to the list of existing RI, and participation in international RIs (international participation with shading).

Number	Acronym	Title
78	MRO*)	Metsähovi Radio Observatory
81	CRYOHALL	Cryohall of the Low Temperature Laboratory
83	JYFL-ACCLAB	Accelerator Laboratory of the Department of Physics
88	MAX-lab*)	MAX Synchrotron Radiation Facility
106	Micronova	Micronova, Centre for Micro-and Nanotechnology
91	ESRF*)	European Synchrotron Radiation Facility
93	ESA	European Space Agency
94	ESO*)	European Southern Observatory
95	CERN	European Organization for Nuclear Research
96	NOT*)	Nordic Optical Telescope
97	EISCAT	European Incoherent Scatter Association
98	JET	EFDA JET - Joint European Torus
99	ITER	ITER

*) See recommendations by PSE Panel below.

2.2. New Research Infrastructures

Five proposals were considered by the PSE Panel, and two considered in parallel with other

Panels, which according to the judgement of the PSE Panel fulfil the criteria of maturity (Table 8).

Table 8. Mature proposals suggested to be introduced to Roadmap (participation in international RIs indicated with shading).

Number	Acronym	Title
R95	JHR MTR (ESFRI)	Jules Horowitz Materials Testing Reactor
R97	FAIR (ESFRI)	Facility for antiproton and ion research
R100	ESRF-Upgrade (ESFRI) *)	ESRF Upgrade
R118	CRYOHALL	Upgrade of cryohall
R121	Micronova	Micronova Centre for Micro- and Nanotechnology
R35	ICOS (ESFRI) *)	Integrated Carbon Observation System
R39	ELIXIR (CSC) (ESFRI)	European Life Science Infrastructure for Biological Information

*) See recommendations by PSE Panel below.

Several interesting proposals and/or concepts, which were considered by the Panel to be important for the development of research, but which are not yet mature in some technical, institutional and/or costing aspects, are identified as “Emerging” ideas. These need further consideration and possible preparatory phase support to reach maturity. As an example, R128 EISCAT_3D European next generation Incoherent Scattering Radar Project was considered as an emerging idea.

2.3. Research Infrastructures, decision pending

The PSE Panel identified four areas where several proposals were presented with well defined and important scientific needs but which were not yet mature as described in the Executive summary (paragraph 3). In these areas there should be an opportunity to submit new proposals before the final decision of the national Roadmap will be made. They are therefore left ‘pending’.

1) Astronomy; the Panel calls for a shared vision to be formed of the perspectives for both optical and radio astronomy in Finland.

- 94 ESO, European Southern Observatory (participation in international RI as a core activity)
- 78 MRO, Metsähovi Radio Observatory
- 84 TO, Tuorla Observatory
- 96 NOT, Nordic Optical Telescope
- R96 E-ELT (ESFRI), European Extremely Large Telescope
- R119 MRO-2, Building Finnish Radio Astronomy’s Future

2) Environment and atmospheric sciences; more momentum could be gained if these activities would be part of a single coordinated research plan.

- 172 Pallas-Sod, Pallas-Sodankylä Super Site
- R33 COPAL (ESFRI), COmmunity heavy-PAYload Long endurance Instrumented Aircraft for Tropospheric Research in Environmental and Geo-Sciences
- R34 EINAR, European Institute for Atmospheric Research
- R35 ICOS (ESFRI), Integrated Carbon Observation System (participation in international RI as a core activity) as a core RI
- R38 SMEAR, SMEAR Stations

3) E-infrastructure; The Panel suggests that CSC together with scientific users develop a coherent strategy for the future of e-infrastructure for Finland, based on properly identified research community needs.

- 170 CSC-Funet, Funet (Finnish University and Research Network)
- 171 CSC-Services, IT Services for Science at CSC
- R106 Funet2030, Funet Roadmap to the next decades
- R107 FGI, Finnish Grid Infrastructure for mid-range computing
- R109 eSCI, e-Infrastructure supporting e-Science

4) Synchrotron radiation; it is necessary to develop an overall perspective for the optimal use of the resources in this area.

- 88 MAX-lab, MAX Synchrotron Radiation Facility
- 91 ESRF, European Synchrotron Radiation Facility (participation in international RI as a core activity for Finland)
- R99 MAX IV
- R100 ESRF-Upgrade (ESFRI)

2.4. Technological Infrastructures

The proposals for the Lappeenranta Laser Processing Centre (105, LLPC) and Reactors Lifetime Management of Finland (124, RELIEFI) were identified as existing national level infrastructures, but the Panel considered that these facilities are sufficiently different in their nature and deserve a separate listing. They should be referred to as technological infrastructures (TI) which are very important for the technical competitiveness of the Finnish economy, but have slightly different goals and should be assessed with different criteria than research infrastructures.

3. LESSONS LEARNED

A strategy should be developed for RI cooperation among the diverse agencies that work in the broad field of sciences and technology. RI projects need a mechanism for bringing in new partners (and new branches) under a joint or common management system. For example, some of the new RI initiatives may benefit from collaboration with existing RI or one of the new proposals. A trend towards integration, instead of fragmentation of initiatives working around the same themes, should be encouraged within the scientific community.

Detailed guidelines are needed to render the process more transparent and structured within and among Panels. Finland as many other countries is still in a learning phase regarding the best practice in selecting the RI proposals with the highest potential for the national or for the ESFRI Roadmap, especially evaluation of multidisciplinary proposals.

More attention should be given to facilitate cooperation between industry and academia regarding RI policies. The PSE Panel introduced the concept of 'technology infrastructures' (TI) on the same line as research infrastructures (RI) which serve more basic research.

The concept of a research *infrastructure* needs to be defined in a way that differ clearly from networking activities between research organizations. Some of the networks may be seeking the RI label to foster high-quality cooperation, although in some cases domestic and international networks may be a more appropriate approach for the participants. Some of the networks may later develop to become a distributed RI.

The Panel work would benefit from more specific guidelines for their technical evaluation in the future. Detailed guidelines would render the process more transparent and well structured within and among different Panels.

- Guidelines should explicitly instruct how Finland defines concept and research policy of national level RI.
- The methodology and procedure concerning the evaluation of proposals which need parallel assessment from two Panels needs to be clarified.

The advice from the Panel is to find mechanisms to increase and improve interaction between science communities to propose joint proposals to the Roadmap.