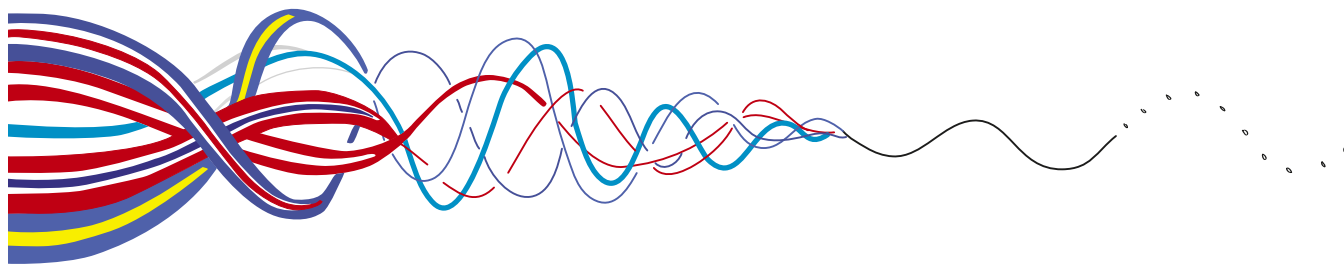


CONFERENCE REPORT

# Joint Nordic Focus on Research Infrastructures – Looking to the Future

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Stockholm 27-28 November 2013





## CONFERENCE REPORT

# JOINT NORDIC FOCUS ON RESEARCH INFRASTRUCTURES 2013

The conference Joint Nordic Focus on Research Infrastructures – Looking to the Future was held in November 2013 as part of the programme during the Swedish chairmanship of the Nordic Council of Ministers. The two-day conference focused solely on Nordic collaboration on research infrastructures. It covered three subject-specific areas of research: Climate & Environment, Health & Welfare and Materials & Molecules.

There were also two interdisciplinary themes which addressed issues relating to all research infrastructures, namely e-Science/e-Infrastructure and Training/Education for research infrastructures. The conference was organised in the form of workshops that addressed burning questions within each topic.

The outcome was a set of “Mission Statements”, one for each of the conference topics. The statements outline each field and describe the roles that research infrastructures have within the field, their potential for supporting world-class research and the challenges they face.

Most importantly, the statements indicate the potential for enhanced Nordic cooperation on research infrastructures, as well as for Nordic added value and increased global competitiveness for the Nordic/Baltic region. The “Action Points” in the statements were highlighted, debated and assessed during the conference workshops. The conference was organised by the Nordic Council of Ministers, the Swedish Ministry of Education and Research, the Swedish Research Council and NordForsk.



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Training and Education for Efficient Cross-Border Use of Research Infrastructures

Chair: Barbro Åsman, Stockholm University.

e-Science and e-Infrastructures: Collaborative Efforts in the International Arena

Chair: Gudmund Høst, Nordic e-Infrastructure Collaboration (NeIC).

Keynote speaker: Kenneth Ruud, UiT The Arctic University of Norway.

Materials and Molecules

Chair: Helen Dannetun, Linköping University.

Keynote speaker: Christiane Alba-Simionesco, Laboratoire Léon Brillouin, France.

Health and Welfare

Chair: Erland Hjelmquist, Swedish Research Council for Health, Working Life and Welfare (FORTE).

Keynote speaker: Mads Melbye, Statens Serum Institut, Denmark.

Climate and Environment

Chair: Magnus Friberg, the Swedish Research Council

Keynote speaker: Markku Kulmala, University of Helsinki.

Panel discussion

Gunnel Gustafsson, NordForsk; Sven Stafström, the Swedish Research Council; Asbjørn Mo, the Research Council of Norway; Peter Sloth, the Danish Agency for Science, Technology and Innovation; Eeva Ikonen, Academy of Finland and Hallgrímur Jónasson, Icelandic Centre for Research.

Overall conference statement:

## Joint Nordic Focus on Research Infrastructures – Looking to the Future

Access to high-quality research infrastructures is of utmost importance for any country seeking to create a strong research environment and produce excellent research. Research infrastructures also provide opportunities to go beyond what a single researcher or research group can do on their own – in some cases even beyond what a single country can do.

Outstanding Nordic research infrastructures are essential tools for addressing the Grand Challenges as well as for attracting the best researchers from all over the world, facilitating new collaborations and fostering interesting projects. This in turn develops society, generates new knowledge, educates people, and creates new innovations.

The challenge for research infrastructures cited most often during the conference was funding, since many research infrastructures are expensive, both to construct and to operate. Another challenge mentioned was attracting the required expertise and dealing with different legal aspects, rules and regulations. With this in mind, it is important to take advantage of the existing research infrastructures, as well as those that will be built in the near future. In order to make the most of research infrastructures, the Nordic region needs to pool its expertise, knowledge and investments. The countries should work together in order to facilitate access to these facilities, spread information about opportunities and train prospective users.

This year's conference was a follow-up to a similar conference in 2008 entitled *Global challenges – Regional opportunities: How can research infrastructure and e-Science support Nordic competitiveness?* Like this year's conference, the main theme in 2008 was Nordic collaboration on research infrastructures. Much has been achieved in the five years since the previous conference was held. There has been increased Nordic coordination related to a number of European Strategy Forum on Research Infrastructures (ESFRI) projects, and Nordic nodes to European infrastructures have been established. NordForsk

has issued a call on joint Nordic use of research infrastructures, and many e-Infrastructure initiatives have been established at the Nordic level.

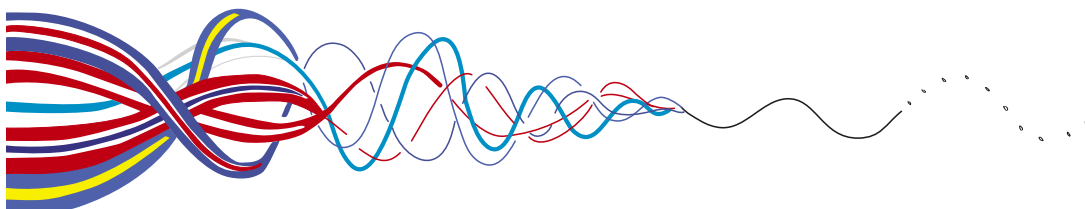
### The next step

There is a need to further develop the existing structures for Nordic collaboration on research infrastructures and to encourage the establishment of new structures where needed. The Nordic stakeholders, together with NordForsk, will have an important role to play in this regard. The individual Nordic countries are successful in research and innovation, but because of their relatively small size, they are also vulnerable. Cooperation is therefore important if the Nordic countries are to become stronger, more attractive partners. Having high-quality facilities and networks in the area is an added value for the entire Nordic region.

### Action points

During the conference, the following action points were formulated:

- Find incentives for operators of existing and planned research infrastructures in the Nordic countries to open up the facilities for cross-border sharing.
- Encourage coordination and streamlining of data management from research infrastructures in the Nordic region.
- Continue efforts to develop new technical solutions for e-Infrastructures.
- Strengthen efforts within the five areas covered by the conference, according to their respective action plans.
- In addition, it was suggested that NordForsk, in close collaboration with Nordic stakeholders, should:
  - Develop a joint Nordic effort on training and education related to research infrastructures.
  - Produce an overview of existing and planned research infrastructures in the Nordic region.



## Opening session

**Kerstin Eliasson**, Chair of the Council for Research Infrastructures at the Swedish Research Council, opened the conference by underscoring the increasing global importance of research infrastructures in almost all areas of science. Common activities



Kerstin Eliasson

between the Nordic countries have existed for quite some time; however, lately Nordic cooperation has taken a leap forward, partly due to projects under the European Strategy Forum on Research Infrastructures (ESFRI), but also due to NordForsk, the activity of the Nordic Council of Ministers and the work of the Nordic research councils. She hoped that the current conference would identify and specify areas in which further steps could be taken.

### Trust – a key asset

**Dagfinn Høybråten**, Secretary General of the Nordic Council of Ministers, noted that the Council strongly supports joint Nordic initiatives on research infrastructures, and it has co-funded the Nordic e-Science Globalisation Initiative (NeGI) to promote Nordic collaboration on e-Science. He pointed out the advantages of being culturally, politically and socially similar, which facilitates



Dagfinn Høybråten

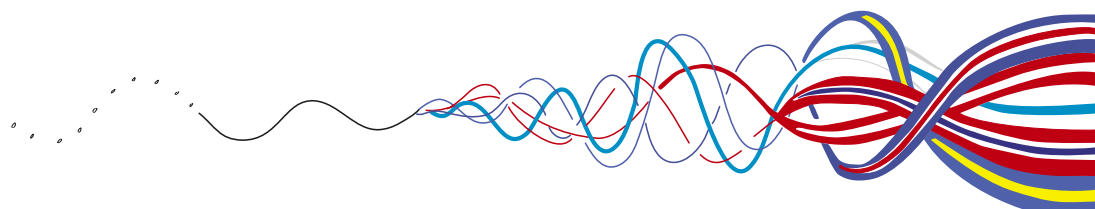
joint projects. Furthermore, he emphasised the importance of the outstanding data and registries in the Nordic countries, which will become even more valuable if they are shared. These data are built on trust, which is a rare commodity in this world. People in the Nordic region trust their institutions and authorities to the extent that they are willing to provide them with key data. The willingness to cooperate, common trust and good data are assets that create a firm foundation for more Nordic research infrastructure in all scientific areas. Regulations should not be seen as irritating obstacles, but as something that preserves our trust in the system and in each other, he argued.

### Nordic collaboration to provide added value

With many economies in Europe under pressure, the Nordic countries, with their comparatively sound financial situation at present, have a certain responsibility for common research infrastructure, said **Peter Honeth**, State Secretary at the Swedish Ministry of Education and Research. During the last eight years, Sweden has increased research funding by some 35 per cent. He described the recent major Swedish undertakings in research infrastructures. He mentioned the Science for Life Laboratory (SciLifeLab) – one of the world's strongest infrastructures for molecular bioscience, with an estimated annual budget of EUR 110 million. He also mentioned the European Spallation Source (ESS), currently the largest European investment in research infrastructure and the synchrotron MAX IV – a major Swedish investment in material and life sciences to complement the ESS. Research infrastructures are often expensive and Nordic collaboration can provide sub-



Peter Honeth



stantial added value. Finally, he highlighted steps taken from the previous conference in 2008 and urged for more specific answers on how Nordic collaboration in this area could be expanded.

**Gunnel Gustafsson**, Director of NordForsk, stated that joint large-scale projects can attract talent



Gunnel Gustafsson

and innovation from all over the world. She also stressed the need to increase the cross-border use of infrastructures, which includes education and training. Research using databases is one particular area in need of new infrastructures. With more and better registries, and better use of existing ones, the Nordic countries can conduct joint clinical trials as well as gain a deeper understanding about phenomena such as youth unemployment. She described what she sees as a natural next step and ambition for the conference: to formulate a joint Nordic policy on research infrastructure.

### Progress since 2008

**Lars Börjesson**, Chair of the Nordic High-level Advisory Group on Research Infrastructure, initiated by NordForsk, reminded the audience of the previous conference in 2008 which identified the huge potential to enhance science and competitiveness through joint Nordic research infrastructures.

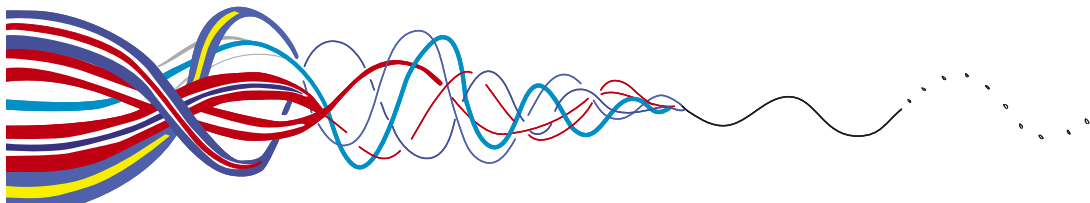
A desire for small and medium-sized research infrastructures was voiced in 2008, as well as a need

for loosely organised cooperation among the Nordic countries that allows for asymmetry between the countries and encourages cooperation when common interests are identified.

Much of this has already occurred, according to Börjesson. NordForsk has issued a call for joint use of research infrastructures. National roadmaps and organisations have been further developed. Funding has been allocated to Nordic research infrastructure. Measures for Nordic coordination related to some ESFRI projects have been carried out. Nordic nodes for the European Molecular Biology Laboratory (EMBL) have been established. Many new projects have been launched since 2008, such as MAX IV, and the decision to situate the ESS in Lund was made in 2009. Ten new ESFRI projects in various disciplines are in the implementation phase, several with Nordic participation. The legal framework for European research infrastructures, ERIC, has been established as a legal entity and so far has been approved for SHARE (health, aging and retirement), CLARIN (language technology) and BBMRI (biobanks), with many more to follow in 2014. He said that the high-level group sees great potential in the increased use of Nordic data sets and registries, and he recommended pilot projects in order to identify obstacles and secure personal integrity, for example by investigating new technical solutions for secure, streamlined handling of data across national borders.



Lars Börjesson



## Keynotes

The conference had four invited keynote speakers who spoke on topics directly reflecting four of the conference themes: e-Science/e-Infrastructure, Climate & Environment, Health & Welfare and Material & Molecules.

**Kenneth Ruud**, Prorector at UiT The Arctic University of Norway, discussed the need for joint Nordic-level High Performance Computing (HPC) infrastructures. He highlighted the importance of HPC for all areas of science and presented the European initiative Partnership for Advanced Computing in Europe (PRACE). He also addressed some of the current issues in e-Science, such as the importance of software development and maintenance, how to handle open access and reproducibility, as well as the issue of rising electricity costs and the potential to overcome this by using green computing. One very important issue is how to ensure funding for e-Infrastructure facilities and identify where responsibility for this lies, he said.



Kenneth Ruud

**Markku Kulmala**, Divisional Director at the University of Helsinki, outlined the Grand Challenges that exist in the area of climate and environmental research. He argued that in order to address these challenges, research infrastructures must be used efficiently and a long-term perspective must be taken. One way to do this is to implement an integrated Nordic vision on research infrastructures, including a joint strategy and roadmap. He also stressed the importance of sustainable funding, as well as knowledge transfer and education.



Markku Kulmala

**Mads Melbye**, Director of the Danish Statens Serum Institut, presented the new Danish infrastructure for health surveillance and research. He emphasised the uniqueness of the Nordic countries in this field thanks to their population-based registries and biobanks, which are pure gold mines for research. The Nordic countries should use this advantage to position themselves at the forefront of areas such as personalised medicine, new screening tools, biomarkers for disease development and new treatment modules, he said.



Mads Melbye

**Christiane Alba-Simionesco**, Director of the Laboratoire Léon Brillouin (LLB), gave a popular science description of the field of neutron scattering, with emphasis on the amazing opportunities that neutron scattering facilities offer to researchers in a wide range of scientific fields. She also pointed out Sweden's successful collaboration with France in the field of neutron scattering research, and she expressed her excitement over the French government's decision to join the European Spallation Source (ESS), which will further increase collaboration between the two countries in this field of research.



Christiane Alba-Simionesco

## Training and Education for Efficient Cross-Border Use of Research Infrastructure

Both education and hands-on training are crucial for developing advanced research infrastructures, and the Nordic countries can benefit from working together. This became evident during the first panel discussion of the conference.

**Barbro Åsman**, Professor at Stockholm University and chair of the panel, used a metaphor in her introduction to describe the difference between training and education: travelling by air, one needs to know that the pilot is not only educated in hydrodynamics



Barbro Åsman

but also has the necessary hands-on skills to manoeuvre the aircraft. The same is true for research infrastructures: you need the formal education to use advanced tools and develop them, but you also need the hands-on training to be able to operate these tools. Successful education and training attracts talent from other countries and supports cross-border exchange. Even though courses and other activities take place all over the Nordic countries, and the participants range from schoolchildren to PhD students and professors, she called for stronger cross-border responsibility to make sure that needs are fulfilled. She also stressed that when planning new research infrastructure, the cost of training and education should be taken in account.

**Martti Louhivuori**, Training Manager at CSC – IT Center for Science in Finland and coordinator for the training centres within the Partnership for Advanced Computing in Europe (PRACE), said that one of the challenges is the gap between funding sources, which can be critical in the development phase, especially when it comes to cross-border activities.

**Kjetil Taskén**, Director of the Norwegian Centre for Molecular Medicine and for the Nordic EMBL Partnership, told the audience about a number of courses being held under the umbrella of EMBL and many other cross-border activities. A typical course is one or two weeks long, to fit in between semesters for students.

**Christiane Alba-Simionesco**, Director of the Laboratoire Léon Brillouin (LLB), said that since it is not possible to perform neutron scattering at a university, LLB has the obligation to train and educate the large number of schoolchildren, PhD students, and professors who come to the laboratory. LLB provides different levels of education, but she underscored the importance of letting the problem, not the technology, guide education.

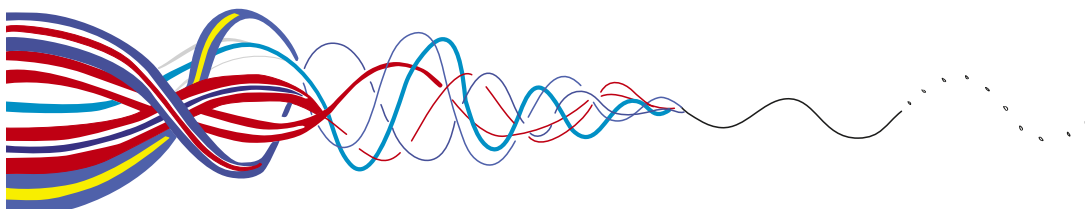
Researchers at the Department of Physics at the University of Helsinki have a lot of experience in teaching students from all over the world to handle complicated instruments. **Markku Kulmala**, Director of the Division of Atmospheric Sciences, has been holding winter courses since 1996; today they are fully booked, although the cost of the courses is largely covered by fees. The teachers and students analyse the data from research infrastructures: they use tools and instruments and report and publish their findings. He reported that one publication from this effort has until now resulted in 260 citations.

**Sverker Holmgren**, Programme Director of the Nordic e-Science Globalisation Initiative (NeGI), sees a growing need for future scientists in all fields to take part in e-Science education, not only by conducting research in this field but also by further



Sverker Holmgren

developing methods. The next step for the NeGI is to gather and present the best existing courses in e-Science in the Nordic region and allocate extra travel funding for students to attend them, as well as to fund the development of new courses in e-Science education.





## Statement: Training & Education

### Action plan

During the workshop, the following action points were formulated:

- Develop a handbook on efficient training and education based on examples from the workshop.
- Develop a platform for funders of training and education.
- Open existing unique training and education for cross-border use of research infrastructures in the Nordic countries.
- Identify the need for training and education for future research infrastructures.

### Outline of the field

Efficient use of research infrastructures requires both knowledge of scientific opportunities and experimental limitations, as well as the necessary skills to get the most out of the instruments and data sources. Traditionally, active researchers have been the drivers of knowledge-sharing through their publications, research groups, PhD students, teaching responsibilities and interest in outreach in a broad sense. If they have been able to arrange specific training or education courses, this has often been linked to their home universities or as summer schools at the research infrastructures. Thus, specific training and education activities have most often been financed either at the university level or at the research infrastructure level. The efficiency of this model comes into question with the increasingly large, expensive and complex research infrastructures that are now being built.

### Role of research infrastructures

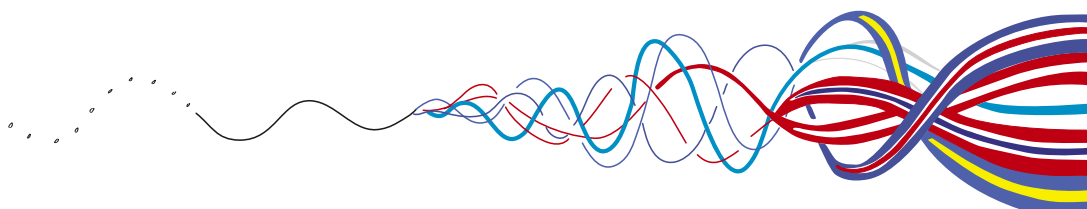
Many research infrastructures are the result of teamwork in which several teams dedicated to different tasks are brought together from many universities and nations to solve the scientific and financing problems associated with building world-class facilities (single sited, distributed or virtual). These research infrastructures are more or less run like companies providing services to the users. The responsibility for training and education is thus transferred from individual researchers to a management team at the facility. Management plays a central role both in terms of efficient and fair use of resources and clear responsibility for the safe use of the facility.

This tendency to centralise activities could be a drawback for users coming from a distance. However, the advent of e-Science and e-Infrastructure online outreach could make geographical location less important. This type of development could even help to give schoolchildren from distant locations an insight into the research infrastructures and the science carried out there through virtual labs. Many of the early developments in the field of training and education have relied on individual initiatives, but have increasingly become part of the operations of research infrastructures.

### Potential for Nordic cooperation

There are several examples of Nordic cooperation related to research infrastructures, and the NORD-SYNC cooperation at the European Synchrotron Radiation Facility (ESRF) is one of these. However, this collaboration focuses primarily on funding issues related to the joint Nordic membership in this facility. A possible expansion of this collaboration, including in the area of training and education, points to both opportunities and challenges. Many of the more specific training needs could benefit from a larger audience than can be reached through a course at a single university department. On the other hand, it is questionable whether it is wise to always tie training and education to a specific research infrastructure. It might be better to give introductory courses, including all kinds of light sources such as synchrotrons and free-electron lasers, instead of focusing on opportunities at ESRF. In both cases, an intermediate level such as the Nordic level could create new opportunities for efficient cross-border use of research infrastructures through training and education.

There is an unexplored possibility for Nordic cooperation either through joint funding of initiatives that are too specialised for individual universities, or through early or broad-based initiatives to strengthen new developments and increase Nordic use of existing as well as future research infrastructures. The use of e-Science and e-Infrastructures for training and education is also very well suited to Nordic cooperation through already existing initiatives in this area.



## e-Science/e-Infrastructure: Collaborative Efforts in the Global Arena

The workshop on e-Infrastructure showcased a wide range of Nordic activities in the international arena, in different fields of science and at different stages, in the form of several short presentations by key persons involved in e-Science.

The chair **Gudmund Høst**, Director of the Nordic e-Infrastructure Collaboration (NeIC), introduced the topic of the session.

**Krister Larsson**, IT strategist at the MAX IV Laboratory, compared his job to managing the Tower of Babel, in the sense that his job involves a constant handling of diversity. The facility handles different levels of accessibility to the data produced. To work with data, researchers need to take it home or send it to other facilities or perhaps to companies, and all this diversity of use must be accommodated. He replied to a question from the floor that he advocates open access to publicly funded data after a certain amount of time, perhaps three years.

**Karin Sundström**, Project Manager at the Nordic Information for Action e-Science Center (NIASC), presented NIASC's work on a five-year plan to develop risk prediction algorithms for breast, colorectal, prostate and cervical cancer. Among other things, they aim to gather data on Nordic populations at risk of cancer, gather biosamples from Nordic countries and develop tailor-made cancer-screening instruments. They also discuss solutions for safe data storage.

**Iloa Riipinen**, Associate Professor at Stockholm University, also discussed the challenge of integrating different kinds of data and modelling as well as climate tools. She called for an integrative approach towards diverse needs for storage and computational power. She underscored the need for a smooth flow of information and data across national borders, synchronised data formats and the need to create platforms for easy accessibility.



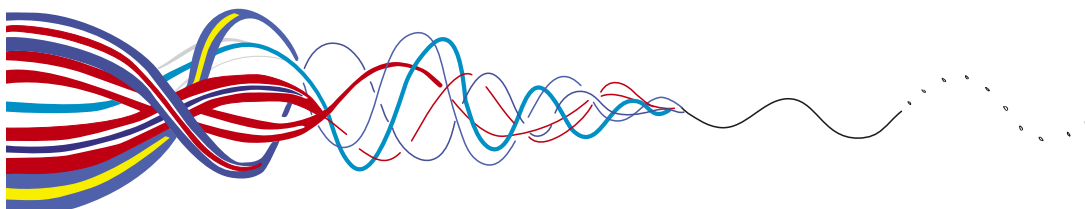
Gudmund Høst

**Michaela Barth**, General Area Manager at the Nordic e-Infrastructure Collaboration (NeIC), presented the NeIC, an organisation funded and administered by NordForsk. It facilitates the development of high-quality e-Infrastructure solutions in areas of joint Nordic interest with a wide array of projects in different fields of technical science. The NeIC is a distributed centre that consists of experts from high-performing computing centres across the Nordic countries. A decision taken in 2013 guarantees the NeIC funding for ten years; this commitment is the longest ever for such a joint Nordic initiative.

**Sverker Holmgren**, Programme Director of the Nordic e-Science Globalisation Initiative (NeGI), described the e-Science action plan that was formulated in 2008 and is now being updated. They will look more closely at how Nordic collaboration can take place in an international context. A major issue concerns data: the amount of data has exploded since the current action plan was put in place, and now the question is how to handle, access, store and facilitate collection of these data. Holmgren made it clear that the updated action plan focuses on added value. The updated NeGI action plan will be presented during the first half of 2014.



Presentations were filmed and live streamed



## Statement: e-Science/e-Infrastructures

### Action plan

During the workshop, the following action points were formulated:

- A strengthened effort to employ Nordic collaboration and existing platforms as a stepping stone to participation in European and global research and research infrastructure initiatives.
- Expanded collaboration on Nordic resource exchange and development of e-Infrastructure resources that is anchored in the European frameworks and explores specific Nordic opportunities in e.g. hosting and operation of computing and data storage.
- An expanded effort on e-Science research that employs synergies at the Nordic level and makes efficient use of existing national expertise through collaborative efforts.
- An expanded effort on Nordic education that covers e-Science tools and techniques, coordinates existing national expertise and utilises modern open education techniques.
- An expanded effort to make Nordic research data available and easy to use across physical and topical boundaries, enabling new modes of open science.
- A new, structured effort to leverage Nordic e-Science application software in an international setting.

### Outline of the field

E-science entails the development and application of modern resources and advanced tools within information and communication technology, known as e-Infrastructures, to exploit new modes of advancing research, complementing theory and experiments through computer-based simulations and analysis of data.

### Role of research infrastructures

Today, the use of e-Science tools and e-Infrastructures in science and innovation is ubiquitous. Indeed, e-Science and e-Infrastructure provide researchers in all branches of research with tools that enable research breakthroughs and provide the basis for large-scale collaboration and open science. E-Science and e-Infrastructures are also essential building blocks for research infrastructures in general. Many research infrastructures generate vast amounts of data that need to be efficiently handled and analysed

using computational tools. Also, many research infrastructures are dependent on powerful simulation software and large-scale computing both for planning and design of experiments and for interpretation of results. E-Science tools for data analysis and simulations provide a horizontal service layer that needs to be considered from the planning stage of research infrastructures.

### Potential for Nordic cooperation

Nordic collaboration on e-Science and e-Infrastructure is highly developed today, and several examples of successful, joint efforts exist. The first Nordic e-Science Action Plan, presented in 2008, has stimulated Nordic efforts on e-Science research and education under the Nordic e-Science Globalisation Initiative (NeGI). Within e-Infrastructure, NORD-Unet has provided and operated Nordic networking services for more than 30 years, and collaboration on data and computing services has been developed in the past decade by the Nordic e-Infrastructure Collaboration (NeIC) and its predecessors.

The necessary vehicles for new and expanded efforts at the Nordic level and platforms for internationally collaborative initiatives are now in place. Today, the Nordic countries are optimally positioned to play a leading role in strategic areas of e-Science and e-Infrastructure. Given that research and research infrastructures are becoming increasingly international and dependent on such techniques and services, the potential impact of a further developed Nordic collaboration is huge.

The Nordic e-Science Action Plan is currently being updated, and examples of areas where Nordic efforts should be further explored are resource-sharing and collaborative Nordic efforts on large-scale computing and storage, collaboration on basic services such as accounting, and cross-border access to data. Within international e-Infrastructures such as GEANT, EGI and PRACE, the potential impact of collaborative Nordic actions and initiatives is very high.



Audience in the main auditorium

## Climate & Environment: Nordic Opportunities for Integration of Environmental Infrastructures

The workshop on Climate & Environment was chaired by Magnus Friberg, Research Officer at the Swedish Research Council. The workshop was designed to share experiences and explore ways forward for Nordic cooperation on research infrastructures in the area. Three ongoing research infrastructure projects in various stages of development were presented and discussed: EISCAT, ICOS and Nordic LifeWatch.

**Craig Heinselman**, Director of EISCAT, presented how EISCAT has successfully operated upper atmosphere and space radars in the Nordic countries for 30 years. **Sanna Sorvari**, Coordinator of ICOS-ERIC, showed how the Nordic countries, together with European partners, have cooperated to establish an integrated monitoring network for measuring Europe's carbon balance through ICOS. **Frank Hansen**, Project Secretary of Nordic LifeWatch, presented plans to integrate biodiversity data across the Nordic countries through the NordForsk-funded initiative.

The workshop participants agreed that joint Nordic efforts in research infrastructures in the area of climate and environmental research should continue to be explored at many different levels. They stressed the importance of opening up existing local and

national infrastructures for Nordic users, developing joint Nordic infrastructure initiatives and finding ways to carry out Nordic cooperation within international infrastructures.



Magnus Friberg

### Statement: Climate & Environment

#### Action plan

During the workshop, the following action points were formulated:

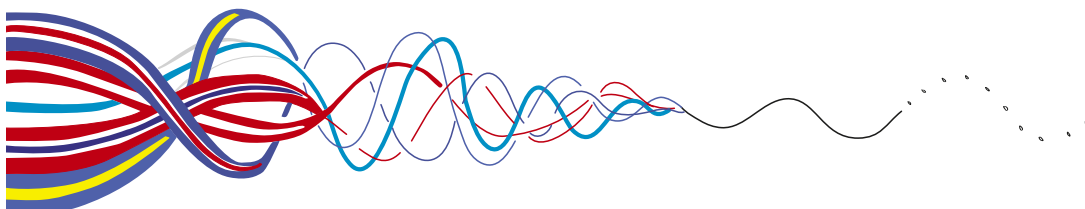
- Establish a Nordic forum to identify and promote environmental research infrastructures of common Nordic interest, with support from institutions at the Nordic level.
- The forum should: identify areas of future cooperation and integration of facilities, identify gaps where common infrastructures are needed and find areas of common Nordic interest in European or international research infrastructures.
- Open existing Nordic infrastructures for cross-border use by finding incentives for the operators to do so.
- The environmental research community and e-Infrastructure providers should find common solutions for data management, user support, integration between platforms, data analysis and modelling tools.
- Support education and training to utilise the full

potential of the infrastructures and foster the next generation of scientists, and secure continued support for exchange programmes.

- Support the research community in its effort to reduce fragmentation and optimise priorities in environmental research infrastructure initiatives across the Nordic countries in order to take advantage of opportunities under Horizon 2020 and international programmes.

#### Outline of the research field

Sustainable management of the environment requires knowledge from environmental science. To understand the Earth's system a multitude of parameters need to be sampled and quantified, from the composition of ecosystems, chemical and physical parameters of air, soil, water and the solid Earth to energy fluxes. There are major challenges in resolving and understanding these parameters to the extent that we can reliably predict e.g. the Earth's processes and response to environmental loads.



## Role of research infrastructures

Research infrastructures are vital for providing the continuity, coverage and quality of data for long-term observations of the environment needed to quantify natural variations in the Earth's systems, its effect on society and the impact of human activities.

These may be multi-site sensor networks for systematic simultaneous measurements of several variables such as air and water composition and geophysical parameters, or sites dedicated to in-situ experiments whereby biological, chemical or physical conditions are altered and the responses observed. Systems for remote sensing as well as e-Science tools for integrating multiple environmental variables from several data sets are important for providing the infrastructure needed to develop the inherently complex Earth system models and quantify environmental risks.

The main challenges for these research infrastructures are to:

- Integrate observation and data across different operators and technologies.
- Develop reliable and cost-efficient sensor systems for continuous, high-resolution environmental observations.
- Maintain observations over longer periods of time and larger areas or volumes instead of point observations.
- Facilitate on-site training and education programmes that include data integration, modelling and simulation.

Most environmental research infrastructures provide on-site education and training, e.g. the joint Nordic research schools conducted under the Nordic Top-level Research Initiative (TRI) programme on cryosphere research.

## Potential for Nordic cooperation

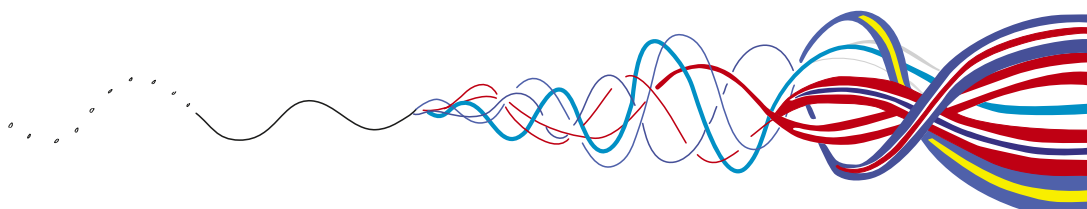
World-leading Nordic infrastructures in environmental sciences, such as the SMEAR stations and the use of the icebreaker Oden for research purposes, act as catalysts for reinforcing their fields. Tools for individual research groups, such as towers to measure atmospheric composition and databases or facilities for ecological and Earth sciences monitoring, often originate as independent facilities, but are later structured into national, Nordic or international distributed research infrastructures by adopting common standards and governance structures. Some success stories are:

- Nordic infrastructures, e.g. Nordsim for high-precision isotope analyses and Nordvulc for geohazards.
- Nordic cooperation in international and European infrastructures, e.g. the ESFRI projects.
- Drilling campaigns in the Baltic Sea and the Scandinavian mountains through IODP and ICDP respectively.
- Nordic Centres of Excellence, e.g. the Top-level Research Initiative (TRI) and the Nordic e-Science Collaboration Initiative (NeGI) programmes on climate and environment with collaboration on infrastructure and e-Science, as well as joint training and education activities.

Informal dialogue to foster collaboration has been important in areas such as integrating biodiversity data under Nordic LifeWatch and the successful Nordic engagement in atmospheric studies by ICOS, ACTRIS and EISCAT and in the Arctic by the station network INTERACT. There is a need to expand this successful Nordic cooperation into other fields and also to other international and European initiatives where there is great interest from Nordic scientists and stakeholders. Possibilities include:

- The Arctic through SIOS, EISCAT\_3D and INTERACT.
- Marine environment through Nordic and European initiatives of common Nordic priority, e.g. BONUS and EMBRC.
- Earth sciences and natural resources in EPOS.
- Experimental ecology by joining national initiatives on research stations and involvement in ANAEE.
- Development of Earth system models within IS-ENES and JPI Climate.
- E-science platforms across the Nordic countries to support Earth system modelling, data integration and access.

A starting point would be to establish a Nordic forum charged with the task of identifying areas in which there are benefits for integrating Nordic environmental infrastructures and finding areas of mutual interest between the Nordic countries in new and existing international infrastructures.



## Materials & Molecules: Nordic Opportunities for Cooperation on MAX IV and ESS

The workshop on Materials & Molecules was chaired by Helen Dannetun, Vice Chancellor at Linköping University. She gave a brief overview of the issues to discuss, followed by presentations on two of the major infrastructures in the area: MAX IV and the ESS.

**Christoph Quitmann**, Director of MAX IV, talked about opportunities for making the invisible visible with MAX IV, and mentioned in particular the importance of training and education for an expanded user community as well as for young scientists. **James Yeck**, CEO at the European Spallation Source (ESS), presented the status of the ESS project, including opportunities provided by the facility. He stressed that community involvement and regional rooting are fundamental factors for success for any large research infrastructure such as the ESS. **Fredrik Melander** of the Danish Agency for Science, Technology and Innovation, introduced a potential NordForsk initiative on neutron research involving a Nordic research school and later also a research programme. **Kurt Clausen**, Head of Department at the Paul Scherrer Institute (PSI), shared his experiences from the PSI related to the co-location of synchrotron and neutron facilities, and the advantages and challenges that this entails.

A panel gave their views on opportunities and challenges related to MAX IV and the ESS from a regional perspective. Participants on the panel were: **Anne Borg**, Dean at the Norwegian University of Science and Technology; **Keijo Hämäläinen**, Dean at the University of Helsinki; **Yvonne Andersson**, Professor at Uppsala University; and **Henning Friis Poulsen**, Professor at the Technical University of Denmark. The importance of involving the user communities was mentioned as a key element in making the most of the facilities. The panel also stressed the importance of moving forward with the policy-level processes.



Presentation during the workshop on Materials & Molecules

### Statement: Materials & Molecules

#### Action plan

During the workshop, the following action points were formulated:

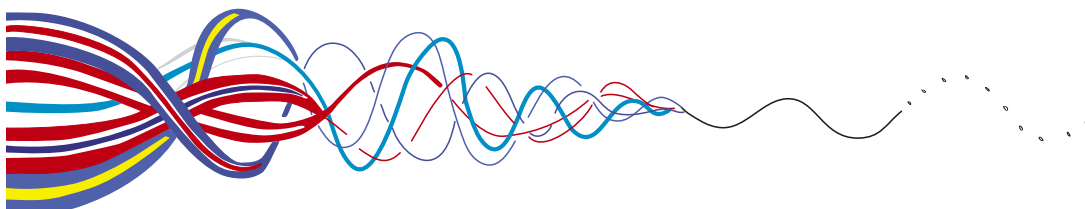
- Create a common umbrella for the synchrotron and neutron scattering communities within the Nordic/Baltic region, possibly by copying or building on existing initiatives.
- Organise joint user meetings and set up expert groups.
- Explore the possibility of funding, via Nordic institutions, joint Nordic/Baltic activities such as training and education initiatives, travelling, planning of beamlines/experiments, and use of the facilities.
- Develop joint Nordic/Baltic PhD courses, research schools and training sessions for synchrotron and neutron users adapted to the users' background knowledge.
- Build on existing cooperation on e-Science in the Nordic/Baltic region to create the necessary sha-

red services for data integration, storage, analyses and modelling.

- Produce a long-term roadmap for providing access for researchers in the Nordic/Baltic region to synchrotron and neutron research infrastructures.

#### Outline of the research field

“Materials and molecules science” can be viewed as a collective name for several different research areas within physics, chemistry, geology, biology and medicine. Modern research in this area aims to see and understand properties of materials and molecules at the atomic level, such as their structure, properties and reactions, and to develop materials with new characteristics. The new multi-disciplinary research infrastructures ESS and MAX IV Laboratory will give researchers a unique opportunity to address research areas where materials and molecules play a crucial role.



## Role of research infrastructures

The rapid development of tools for analysis of materials and molecules has resulted in enormous advances within research fields related to the physical, chemical and life sciences. This development concerns light sources (synchrotron radiation and free electron lasers) and neutron sources (fission reactors and spallation sources), as well as laboratory-based techniques such as electron microscopy and magnetic resonance techniques. The technical development is expected to continue during the coming decade, raising great expectations for the future.

Research infrastructures such as MAX IV and the ESS are outstanding facilities that develop unique solutions generating completely new scientific results. To ensure success, it is necessary to attract skilled professionals from across Europe and beyond to participate in planning and constructing facilities. Visionary scientists, as well as technical and administrative experts, all have an important role to play. Another challenge is to approach new user groups and include them in planning activities. As facilities such as the ESS and MAX IV generate huge amounts of data, it is crucial to include a plan for data handling at an early stage when planning research infrastructures.

During the preparatory phase of setting up large-scale research infrastructures, a significant amount of work must be devoted to establishing agreements to define the organisational structure as well as a model for sharing costs and available beam time.

## Potential for Nordic cooperation

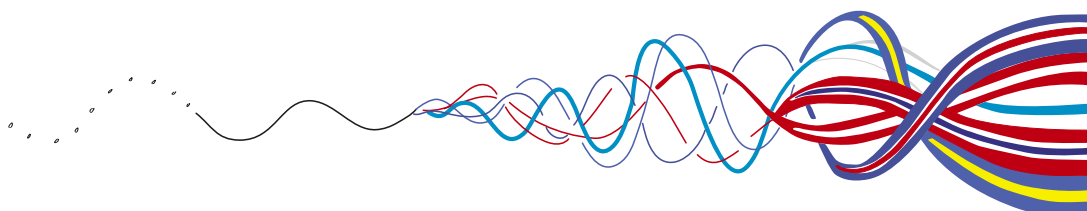
To stimulate scientific exchange within as well as between different research areas, there is a need for long-term involvement on the part of all stakeholders on technical development and in terms of financial commitment. At a workshop earlier in 2013 about future opportunities in connection with the MAX IV Laboratory, participants identified great potential for cooperation on beamline development and coordination of education and training. In the

case of the ESS, several initiatives for joint Nordic collaboration have been launched. It is necessary to take an approach that includes long-term initiatives, such as competence development, as well as expansion of the research community to make the most of these opportunities.

In order to serve the users in the Nordic/Baltic region in the best possible way, it is essential to organise research schools and workshops that provide the necessary scientific training. It is also essential to provide technical assistance to the users, in particular to infrequent visitors, as well as training on current methods and technologies and new methods that come with the new sources. These should be adapted to suit both experienced users and new user groups. Measures such as facilitating travel, offering support for experimental work at research infrastructures, and preparing experiments and analysing data within collaborative projects may also be crucial for attracting a wide user community.

A joint umbrella for the synchrotron and neutron user communities within the Nordic/Baltic region could strengthen research in the area and provide new impulses. The Danish model for organising this (known as DanScatt) could perhaps serve as a model. It should be investigated whether NORDSYNC, the existing Nordic cooperation around the ESRF synchrotron, could be expanded to encompass this broader task or if a new organisation would serve this purpose better. A bonus of a joint organisation for the Nordic/Baltic region is the possibility for the participating countries to act as a stronger partner in international collaborations.

The Nordic countries have a strong tradition of cooperation on e-Science for data storage, computing and modelling. Existing structures, such as NORDUnet and the NeIC, complemented with specialised tools, will facilitate the involvement of new users and non-traditional communities and allow the science around MAX IV and the ESS to grow.



## Health & Welfare: Nordic Opportunities for Research Cooperation on Bio- banks, Databases, Registries and Interventional Research

The workshop on Health & Welfare was chaired by Erland Hjelmquist, Secretary General at the Swedish Research Council for Health, Working Life and Welfare. He introduced the topic of the workshop: "How to facilitate and strengthen Nordic cooperation in research involving registry data and biobank samples".

Four scientists presented their experience with sharing Nordic resources for science: **Viggo Nordvik**, Deputy Leader of the Nordic Centre of Excellence in Welfare Research, discussed the Nordic welfare model; **Jan-Eric Litton**, Director General of BBMRI-ERIC, presented the Nordic biobank initiative; **Pierre Lafolie**, Project Leader at the Nordic Trial Alliance, addressed Nordic cooperation in clinical research; and **Kjetil Taskén**, Director of the Norwegian Centre for Molecular Medicine, talked about the Nordic EMBL partnership.

Erland Hjelmquist presented work carried out by the NORIA-net on registries working group initiated by NordForsk. The purpose of this group is for funders and policymakers to take preparatory action towards establishing a Nordic data sharing framework. The work concerns social and health registries

as well as biobanks. The NORIA-net working group will give advice to the NordForsk Board on how to increase joint Nordic use of registries.

The workshop was concluded by a panel discussion on the same topic as the workshop itself. The panel members were: **Mads Melbye**, Director of the Danish Statens Serum Institut; **Vigdis Namtvedt Kvalheim**, Associate Director of the Norwegian Social Science Data Service (NSD); **Salvör Nordal**, Director of the Icelandic Centre for Ethics; **Niels Ploug**, Director of Social Statistics at Statistics Denmark; and **Marjut Salokannel**, independent consultant in information law.

### Statement: Health & Welfare

#### Action plan

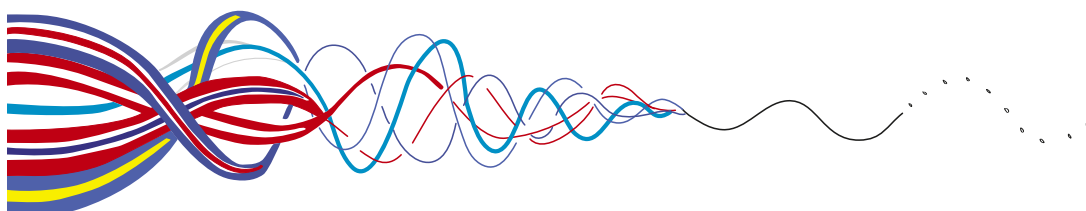
During the workshop, the following action points were formulated:

- Simplify Nordic research support operations carried out by the Nordic bureaus of statistics, national health registry institutes and other registry hosting bodies.
- Set up procedures of mutual recognition for ethical review permissions between the Nordic countries.
- Support approximation of Nordic legislation and practices for using personal data in cross-border research.
- Support the development of technical solutions that enable secure transfer, storage and access to research data across borders, possibly through the Nordic e-Infrastructure Collaboration (NeIC).
- Investigate the possibility of creating a unified data sharing facility in each country, such as the Danish solution on health data.

- Launch funding schemes for research pilots and training programmes aimed at using joint Nordic data sources.
- Set up a Nordic initiative to support, monitor and develop registry-based research.

#### Outline of the research field

Research in health and welfare includes a broad range of scientific disciplines such as the humanities, social and behavioural sciences, statistics, medicine and biology. The overall goal is to better understand how demographic, social, environmental and biological factors affect human health and entail challenges for human welfare and to translate such new knowledge into practical solutions in healthcare and welfare systems. The benefits are more precise disease classifications, more effective cures for patients, better disease prevention and efficient welfare systems. One of the main challenges is the often limited access to harmonised individual data which are large enough to allow adequately powered statistical analyses of complex problems.





## Role of research infrastructures

Research in health and welfare heavily depends on methods to collect, store, analyse and reuse demographic, social, environmental and medical/biological data on individuals to draw general conclusions, ultimately about causal relationships. Important infrastructures are national registries containing personal data, research databases, biobanks (human tissue samples) together with experimental platforms to extract molecular and other types of data from the samples, and e-Science tools for data storage and analysis. One key challenge for infrastructures in this field is to coordinate data contributions from a large number of diverse stakeholders, such as statistical bureaus, local biobanks or healthcare providers, many of which do not have research as their focus. Typically, the data provided by these infrastructures are also sensitive from a personal integrity perspective, and considerable work is often required to adapt working procedures to national and international legislation and ethical standards.

The task of harmonising formats for samples and data and penetrating the diverse jungle of legal and procedural rules in order to enable broader access and collaboration has proven non-trivial. In order for the Nordic countries to set up an infrastructure that fully exploits the unique potential in this field of science we need to pool the will and wisdom of politicians, governmental data organisations, research funders and scientists alike.

## Potential for Nordic cooperation

The Nordic countries have a leading position in this field, largely as a result of their extensive healthcare records, personal registries and human sample collections. These national resources have been maintained by the healthcare systems and other national

authorities, and are now unique assets for research in a global perspective as well. As studies based on this kind of data depend on large data sets to provide statistical power for complex causal questions, the possibility of consolidating data sources from the Nordic countries is of importance for international competitiveness. Together, the Nordic countries have a population of over 25 million individuals, as compared to the relatively small population of the individual countries. In addition to the registries and biobanks, a large number of longitudinal databases have been built up for research purposes, not least concerning welfare issues. The Nordic countries have world-leading scientists and expertise in all of the research fields that are opening up through access to these rich personal data. The landscape is therefore favourable from a Nordic perspective, but the challenges in terms of harmonisation and accessibility must be approached with purpose and urgency in order to keep up with global development. Nordic initiatives have been launched by NordForsk and the Nordic Council of Ministers that aim to identify and overcome existing obstacles that impede data sharing across borders.

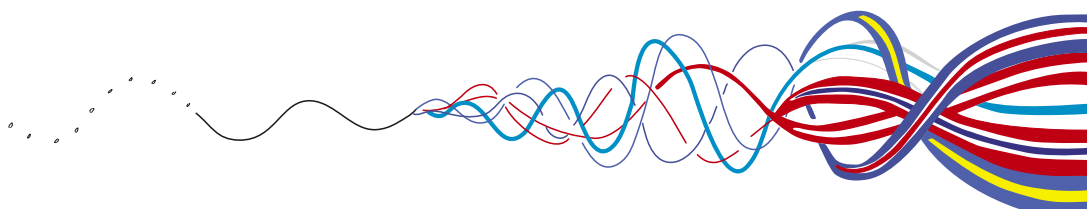
Based on these common strengths and interests, the Nordic countries are together an important partner in the implementation and development of many European research infrastructure projects. These include the European Social Survey (ESS), the Council of European Social Science Data Archives (CESSDA), the Survey of Health, Ageing and Retirement in Europe (SHARE), Biobanking and Biomolecular Resources Research Infrastructure (BBMRI), Bioinformatics (ELIXIR), Biomolecular Laboratories (EMBL) and Translational Medicine (EATRIS).



Panel discussion on the topic of Health & Welfare.



A question from the audience in the main auditorium.



## Panel Discussion: Joint Nordic Focus on Research Infrastructures – Looking to the Future

The conference concluded with a panel consisting of representatives of Nordic funding agencies. The debate revolved around the question of how to strengthen Nordic cooperation among research funders. The panel had different opinions on this, but agreed that joint Nordic initiatives can provide added value and that NordForsk is a key actor.

Moderator **Eva Stensköld**, Desk Officer at the Swedish Ministry of Education and Research, started off the final panel discussion by addressing a handful of questions that consolidated the main themes of the conference: how to develop e-Science, particularly regarding registry research; how to open existing national research infrastructures for Nordic use; how joint training and education can be initiated; and how NordForsk can become an even stronger actor as a facilitator for national initiatives. Stensköld also asked the panel participants to share their strongest impression from the conference and outline their take-home message.

**Gunnel Gustafsson**, Director of NordForsk, said that, here and now, she sees a window of opportunity for Nordic cooperation on research infrastructures. There is a need to cooperate in many fields, and it is important to develop small and medium-sized research infrastructures, she stated. Earlier in the conference, she advocated the idea of a joint Nordic infrastructure policy and spoke more specifically on that matter. The policy should be used to determine how to prioritise and handle the crucial question of funding. Today, funding is too fragmented, even at the national level, she argued.

**Sven Stafström**, acting Director General at the Swedish Research Council, underscored the fact that we are not yet exploring the full potential of research infrastructures and that science is not limited to the Nordic region – there is a bigger stage to act on. Although Nordic research infrastructures definitely add value and excellence, there is a cost connected to starting collaborations and therefore a need to prioritise. The payoff comes in the longer term, but one cannot start too many projects at a time, he argued.

**Peter Sloth**, Head of Division for Research Infrastructure, Danish Agency for Science, Technology and Innovation, agreed on the importance of prioritising, but added that it also means closing down projects that are no longer top priority. He thought the conference focused too much on the top-down perspective and he said that he is not a believer in a joint Nordic research infrastructure policy or com-

mon roadmaps. He would rather see more loose collaborations between universities and research groups and suggested that the national research councils should work with white papers and other more informal agreements in which NordForsk should have a role. He agreed with Stafström that the different Nordic countries act in a global arena and argued that an artificial Nordic approach would not be productive. Added value can only be found where there is a common interest, he stated.

**Gunnel Gustafsson** replied with an example of strong common interest: registry research and handling of data sets. It could lead to many common benefits, she replied, although it would cost money and require the approval of high-level funders. It would also need high-level politicians to solve the ethical issues.

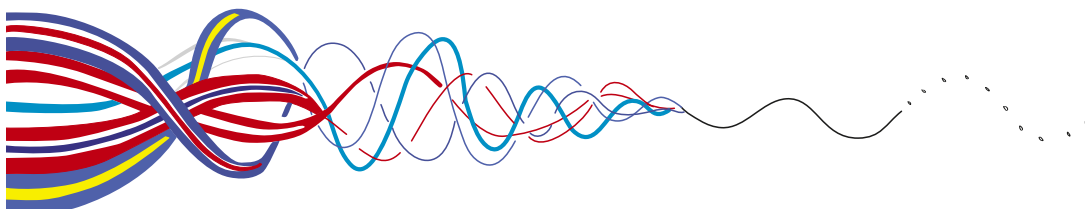
**Sven Stafström** commented on the discussion of joint Nordic policy: even if the countries make their own roadmaps, they can have the Nordic dimension in mind when they write the maps and identify issues where they can find common ground.

**Eeva Ikonen**, Senior Science Adviser at the Academy of Finland, was eager to make Nordic research infrastructures more visible in the international and European arenas, and she noted the same ambition among other participants at the conference. To that end, she suggested that NordForsk serve as a facilitator. Furthermore, she reminded the panel about the tougher conditions for the next ESFRI round in 2016. Three countries with funding commitments will be required to back every proposal, which makes a joint Nordic policy discussion even more urgent. She also addressed the issue of bottom-up or top-down processes.

**Asbjørn Mo**, Director of Research Infrastructure at the Research Council of Norway, argued that good



Peter Sloth



leadership is crucial for accomplishing a good bottom-up process, noting that the examples highlighted at the conference are most probably among the best. He agreed with Gunnel Gustafsson in wanting a common policy, not least to find common ethics for cross-border data use, as well as to carry out the challenging task of determining more precisely how to share the work between the national providers of research infrastructures. The problem with white papers, he said, is that they tend to contain everything and that goes against the ambition to prioritise.



Asbjørn Mo and Eeva Ikonen

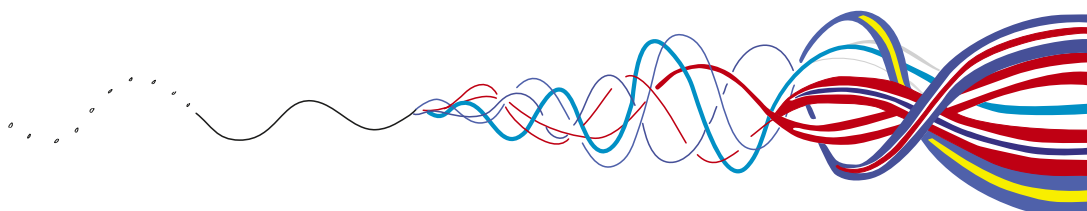
**Hallgrímur Jónasson**, Director General of the Icelandic Centre for Research, said that this conference had made him realise how intense Nordic cooperation actually is and how far it has already come. He noted that e-Science is a field that has been highlighted and is indeed very important. He also agreed with many of the other panel members that it is important to prioritise when it comes to financing research infrastructure projects.



Hallgrímur Jónasson

Questions from the floor raised the issue of how to share the use of research infrastructures in the Nordic region. **Asbjørn Mo** replied that research infrastructures are often not a local phenomenon, even though they are obviously located somewhere. Researchers are nomads for whom location is seldom a problem; why do something at home if you can do it better and more specialised in another country? He further argued that there is a need for common Nordic awareness of the real costs of research infrastructures, as operational costs are always connected to research infrastructures, even the smaller ones that have reasonable construction costs. Hallgrímur Jónasson also emphasised the importance of sharing the research output from research infrastructures and that, from an Icelandic perspective, there was a willingness to do so.

**Katarina Bjelke**, Director General of Research Policy at the Swedish Ministry of Education and Research, summarised the conference and thanked its organisers and participants. In her opinion, the conference touched upon crucial issues and she reminded the audience about the Nordic countries' strengths (high-quality research) and vulnerabilities (small size). She said that research infrastructure can indeed create good environments for excellent research, help the Nordic countries to solve the major challenges of our time, attract international talents and create innovations. The challenge is that research infrastructures are often extremely expensive, which implies the need for Nordic collaboration. Katarina Bjelke's take-home messages were: 1) there is a need for training and education in using e-Science and developing research infrastructures, which should be coordinated by NordForsk in close collaboration with the national funders, and 2) there is a need to produce an overview document of the existing facilities in the Nordic countries.



# Joint Nordic Focus on Research Infrastructures – Looking to the Future

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