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TOWARDS NEW RESEARCH INFRASTRUCTURES FOR EUROPE:

The ESFRI "List of Opportunities"

March 2005

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European Strategy Forum on Research Infrastructures

Brussels, 22 March 2005

The Chairman

European Commission
Commissioner J. Potocnik
200, rue de la Loi
B - 1049 Brussels
BELGIUM

Subject: New Research Infrastructures ("tools for science"):
The ESFRI "List of Opportunities"

Dear Commissioner Potocnik,

Please find in annex a "List of Opportunities" with concrete examples of new, large-scale Research Infrastructures which the scientific community in Europe will need in the coming decade. It is hoped that this list, which was adopted by ESFRI at its meeting of 25 February 2005, will assist the Commission in the preparation of its proposal for Framework Programme VII. Furthermore, the publication of this list should encourage scientific communities to speed up their reflections on new Research Infrastructures of pan-European interest and to inform ESFRI of their views.

ESFRI's main line of action in the years 2005-2006 will be the development of a European Roadmap for new, large-scale Research Infrastructures. We hope that once the first versions are available, these will be considered by you and by Research Ministers as a useful instrument for decision-making at the appropriate level.

As such, ESFRI is taking concrete steps to follow-up the Informal Competitiveness Council of 1-3 July 2004 in Maastricht (NL), in which Ministers "*welcomed the Commission's proposal to develop a strategic roadmap for Europe in the field of Research Infrastructures for the next 10 to 20 years*" and, in this context, underlined that "*the European Strategy Forum for Research Infrastructures (ESFRI) could play a role of increasing importance*".

At its meeting of 3 September 2004, ESFRI committed itself to this important challenge and began preparations for the development of a European Roadmap for new, large-scale Research Infrastructures. In this context, ESFRI published a Communication on 17 December 2004 to inform the scientific community in Europe about this process, as well as the criteria and working methods that will be used.

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As part of this process ESFRI established three Steering Groups to provide advice in the following fields:

- Physical Sciences and Engineering - Chair: John Wood,
- Biological and Medical Sciences – Chair: Ruth Barrington,
- Social Sciences and Humanities - Chair: Björn Henrichsen.

Since the compilation of the "List of Opportunities" is the last action in my capacity as Chairman of ESFRI, I would like to thank you and your services for the excellent cooperation as well as for the trust and recognition which you have given to ESFRI.

Yours sincerely,

Hans Chang
ESFRI Chair

Annex: Methodology, list of projects and
description sheets for the individual projects

About ESFRI

The European Strategy Forum on Research Infrastructures - ESFRI - was launched in April 2002 to support a coherent approach to policy-making on Research Infrastructures in Europe. The Forum brings together representatives, nominated by Research Ministers, of the 25 EU Member States and of 7 European countries associated with the Framework Programme, and a representative of the European Commission. ESFRI has set up various thematic working groups, has acted as an incubator for some Research Infrastructure projects and has started to prepare a Roadmap for Research Infrastructures of pan-European interest in the next 10-20 years.

For more information on the Forum: http://www.cordis.lu/esfri/

What are Research Infrastructures?

In this context, the term "Research Infrastructures" refers to tools that provide essential services to the scientific community for basic or applied research. These may concern the whole range of scientific and technological fields, from social sciences to astronomy, through genomics and nanotechnologies. Examples include libraries, databases, biological archives, clean rooms, communication networks, research vessels, satellite and aircraft observation facilities, coastal observatories, telescopes, synchrotrons and accelerators. They may be "single-sited", "distributed" or "virtual".

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TOWARDS NEW RESEARCH INFRASTRUCTURES FOR EUROPE:

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1. INTRODUCTION

Following a request from the European Commission, ESFRI decided at its meeting of 17 December 2004 to compile a “List of Opportunities” in order to assist the Commission in the preparation of its proposal for the Seventh Framework Programme (FP7).

The “List of Opportunities” is a “balanced set of examples of concrete and mature projects for new Research Infrastructures of pan-European interest which could be developed during the course of FP7 (2007-2013).

2. DESCRIPTION OF THE PROCESS

The “List of Opportunities” presented in this document is the result of an intensive three-step process[1] involving a broad consultation of the main stakeholders via the ESFRI national delegations, an analysis of proposals according to clear criteria by the ESFRI Steering Groups and a final discussion in a plenary ESFRI meeting.

STEP 1*: Proposals from the ESFRI delegations*

Immediately after the 17 December meeting, the Secretariat asked the ESFRI delegations to collect proposals for new Research Infrastructures and to act as a “clearing house” for these. Each of the three ESFRI Steering Groups, acting as a whole body, was also invited to introduce proposals. A one-page template was provided for the description of each project, including the following items:

- Project’s name and descriptive title;
- Short description of project and main characteristics;
- Science case (scientific justification, including new areas to be opened);
- Impact on society and on new technologies for industry;

[1] This process was led by the ESFRI Chair, Hans Chang, and Executive Secretary, Jean-Louis Picqué, with major contributions from the Chairs of the ESFRI Steering Groups, Björn Henrichsen, Ruth Barrington and John Wood, and the active participation of the members of ESFRI and the ESFRI Steering Groups.

- Strategic importance to ERA;
- Maturity of proposal (including possible timetable);
- Budgetary information;
- Possible partnerships.

A total of 149 proposals were received. The Secretariat distributed these proposals to ESFRI members on 26 January 2005.

STEP 2: ***Analysis by the ESFRI Steering Groups***

The Chairs of the three Steering Groups circulated the received proposals relevant to their area (65 proposals for PSE, 48 proposals for BMS, 36 proposals for SSH) amongst their group. The Steering Groups met individually in early February. Each group was asked to select a limited number of proposals in its area, by assessing them against the criteria established for the Roadmap process (see box on the criteria) and taking into account the maturity of each project in relation to FP7.

The recommendations of the three Steering Groups were sent to the Chair and Secretariat in the form of a list of selected proposals together with an explanatory note. This information, including 29 proposals in total, was immediately distributed to ESFRI members in view of their meeting of 25 February 2005. The description sheets prepared by the Steering Groups for these proposals were also made available at the meeting.

The ESFRI Steering Groups

At its 17 December 2004 meeting, ESFRI adopted an important Communication on the European Roadmap which aimed to inform the scientific community in Europe about the process to be followed and the working methods and criteria to be used. As part of this process, the Forum established three Steering Groups to give advice on in the following areas:

- ***Physical Sciences and Engineering (PSE) - Chair: John Wood***
- ***Biological and Medical Sciences (BMS) – Chair: Ruth Barrington***
- ***Social Sciences and Humanities (SSH) - Chair: Björn Henrichsen.***

The Steering Groups are chaired by ESFRI members. The countries represented in ESFRI and the European Commission have been invited to nominate a delegate in each Steering Group.

STEP 3: ***Agreement of ESFRI on the "List of Opportunities"***

The objective at the ESFRI plenary meeting on 25 February was to fine-tune the recommendations of the Steering Groups and to agree on a sharper, "balanced" list of projects. The following rules were set: the proposals had to comply with the agreed criteria (see box); in particular, the criterion of maturity was emphasised: the projects had to be mature enough to start spending funds during the course of the Seventh Framework Programme (2007-2013). In addition, to be included in the final list, the projects had to be supported by a sound and concise description sheet, providing in the one-page template all essential information including the scientific case, the construction costs and the time planning.

A number of "global projects", such as ITER and the International Linear Collider (ILC), have a strong input from European countries. It was decided that some of these projects would be mentioned in addition to the list, but description sheets would not be produced.

On this basis, and after an in-depth discussion during which some projects were eliminated and others combined, ESFRI members finally agreed on a set of 23 projects. The description sheets of the 23 projects were reviewed and finalised by the Steering Groups after the meeting.

<u>The criteria</u>

The criteria are listed in the ESFRI Communication of 17 December 2004:

<u>Scientific / Strategic criteria</u>

The infrastructure projects should:

ü ***correspond to a real need for the development of the field in Europe***

ü ***be supported by the appropriate scientific community at European level***

ü ***be of pan-European interest***

ü ***entail multi-user facilities offering an open access (physical or virtual) for scientists from all over Europe***

ü ***be relevant at international level.***

<u>Technical and financial criteria</u>

The infrastructure projects should:

ü ***be timely and mature***

ü ***be technologically feasible***

ü ***open new possibilities or offer improved technological performance***

ü ***have evaluated construction and operating costs***

ü ***offer good possibilities for European partnership and commitment of major stakeholders.***

3. OVERVIEW OF THE RESEARCH INFRASTRUCTURE PROJECTS

The "List of Opportunities" agreed by ESFRI is presented in the table on the next page. This is followed by the description sheets of the 23 projects.

The ESFRI "List of Opportunities" includes, without any order of priority, 23 Research Infrastructure projects which correspond to major needs of the European scientific community in the coming years. The development of such Research Infrastructures is necessary to maintain Europe's position at the cutting-edge of world research.

The list is well-balanced in terms of the scientific fields covered. It includes:

- *4 projects in physics and astronomy*, corresponding to large-scale facilities for nuclear physics, astroparticle physics and astronomy;
- *1 project on nanotechnologies*, distributed over several sites;
- *4 projects for multidisciplinary facilities* for the analysis of matter (material and biological): three of these concern new generation sources for neutrons (spallation source) and photons (free electron lasers); the fourth is an upgrade of the European third generation synchrotron;
- *1 project in supercomputing* for applications in various fields;
- *4 projects in environmental sciences*, ranging from coastal research to biodiversity;
- *7 projects in biological and medical sciences*, including some with a clear biomedical character;
- *2 projects in social sciences and humanities*, based on the collection of data throughout Europe.

The list includes medium and large-scale projects, with costs ranging per project from less than €100 million to more than €1 billion. In a number of cases, especially in biology, the projects consist of a network of facilities located in several countries.

In addition to the list of 23 projects to be developed within Europe (with possible participation from other countries), ESFRI compiled a short-list of "global projects" to be developed at world level, in which Europe is already involved at least in the early stages.

ESFRI "LIST OF OPPORTUNITIES"

Physics and Astronomy

Nuclear Physics

- ***Facility for Antiproton and Ion Research (FAIR)***
- ***Facility for intense secondary beams of unstable isotopes (SPIRAL II)***

Astroparticle Physics

- ***European deep-sea neutrino telescope (KM3NeT)***

Astronomy

- ***Extremely Large Telescope (ELT) – for optical astronomy***

Nanotechnologies

- ***Pan-European Research Infrastructure for Nano-Structures (PRINS)***

Multidisciplinary facilities - Analysis of matter

- ***European Spallation Source (ESS) – neutron source***
- ***European XFEL – for hard X rays***
- ***IRUVX FELs Network – from infrared to soft X rays***
- ***ESRF upgrade – synchrotron***

Computing and Networking

- ***High Performance Computer for Europe (HPCEUR)***

Environmental Sciences

- ***Marine vessel for coastal research – essentially Baltic Sea***
- ***Research Icebreaker Aurora Borealis***
- ***European Multidisciplinary Seafloor Observatory (EMSO)***
- ***European infrastructure for research in, and protection of, biodiversity***

Biological and Medical Sciences

- ***Advanced infrastructure for brain and whole body imaging***
- ***Bio-informatics infrastructure for Europe***
- ***European network of advanced clinical research centres***
- ***European network of bio-banks and genomic resources***
- ***High security laboratories for emerging diseases and threats to public health***
- ***Infrastructure for functional analysis of a whole mammalian genome***
- ***Model testing facilities for biomedical research***

Social Sciences and Humanities

- ***European Research Observatory for the Humanities and Social Sciences (EROHS)***
- ***European Social Survey (ESS)***

"Global projects"

- ***ITER***
- ***International Space Station (ISS)***
- ***International Linear Collider (ILC)***
- ***Square Kilometer Array (SKA) – radio telescope***
- ***International Fusion Materials Irradiation Facility (IFMIF)***

DESCRIPTION SHEETS

OF THE PROJECTS

1. *Project:* FACILITY FOR ANTIPROTON AND ION RESEARCH (FAIR)
International facility for high energy primary and secondary beams of ions of highest intensity and quality, including an "antimatter beam" of antiprotons.
2. Short description of project and main characteristics
FAIR, planned by the European and international science community for construction at the GSI Laboratory in Darmstadt, Germany, foresees the broad implementation of ion storage/cooler rings and of in-ring experimentation with internal targets. Two superconducting synchrotrons will deliver high intensity ion beams up to 35 GeV per nucleon for experiments with primary beams of ion masses up to Uranium and the production of a broad range of radioactive ion beams including antiprotons. This will provide the European community with worldwide unique accelerator capabilities. It will allow the broad, and in many respects novel use of stored, cooled ion beams with superior beam phase space. It will open new frontiers in several areas of research and allow experimentation at high luminosity with unsurpassed precision.
3. Science case (scientific justification, including new areas to be opened)
The concept of FAIR was developed by the international science community and the GSI Laboratory. It builds, and substantially expands on the many seminal developments made by GSI and its international users over the last decade in cooler-ring technology and physics for high-energy heavy ion beams. The ring system will provide for a highly parallel operation between several research programs, from QCD studies with cooled beams of anti-protons, to nucleus-nucleus collisions at highest baryon density, to nuclear structure and nuclear astrophysics, high-density plasma physics, atomic and material science studies and other interdisciplinary uses.
4. Impact to society and to new technologies for industry
GSI has demonstrated with the worldwide unique development of the cancer therapy with heavy ion beams and by many other technical developments that a facility for basic research delivers important novel scientific and technical methods with a large impact for society and a broad potential use in industry. The FAIR facility will contribute not only to a better understanding of several areas of basic research, but also of the physics in the future energy production method of “Inertial Confinement Fusion” and to a better knowledge of the cosmic ray effect on humans.
5. Strategic importance to ERA
FAIR will provide the European science communities in nuclear physics with a worldwide competitive and in may respects superior facility. FAIR will be fully competitive with RIKEN in Japan. It is somehow complementary to RIA in the United States of America in the field of radioactive beams. It will be unique with its bunched beams. FAIR will be also unique with its antiproton beams for QCD studies.
6. Maturity of proposal (including possible timetable)
In 2003 the German Federal Government announced approval of the project, with Germany providing up to 75% of the needed funding (65% federal, 10% State of Hessen). An International Steering Committee has been installed in February 2004 with the intention to work out and agree on a contract for the establishment of the international accelerator laboratory FAIR. It is planned to sign an intergovernmental agreement which defines the legal and organisational form of FAIR and the contributions (in-kind or financial) of all member countries in summer 2006. Until the end of 2004 the following member countries have signed a Memorandum of Understanding (MoU) which expresses the intention to participate in the construction and operation of FAIR: Finland, France, Germany, Greece, Italy, Russia, Spain, Sweden, United Kingdom. Poland has decided to sign the MoU, too. The start of the construction is foreseen for the beginning of 2007. The operation of FAIR will begin in 2011 on the accelerators. The full performance with the parallel operation of all experimental programs will be reached in 2014.
7. Budgetary information (preparation, construction and operation costs)
The investment costs including R&D, additional personnel for the construction period and including cost escalation amounts to approximately €984 million. A first estimate of the operating costs is ~€140 million per year.

1. Project: SPIRALII@GANIL (A new facility for intense secondary unstable rare isotopes.)
2. Short description of project and main characteristics
SPIRAL II is based on a high power, CW, superconducting driver LINAC, producing 5 mA of deuteron beams at 40MeV (200KW) directed on a Uranium target and producing therefore more than 10^{13} fissions/s. The produced beams intensities for exotic species in the mass range from A=60 to A=140, of the order of 10^{6} to 10^{11}pps will surpass by two order of magnitude any existing facilities in the world. These unstable atoms will be available at energies between few KeV/n to 15 MeV/n. The same driver will accelerate at high intensity (100MicroA to 1 mA, world record), heavier ions up to Ar at 14 MeV/n producing also proton rich exotic nuclei.
3. Science case (scientific justification, including new areas to be opened)
The physics case is clearly to extend our knowledge of the limit of existence of nuclei deeply in the medium and heavy mass region (A=60 to 140) which is to day an almost unexplored continent. This is largely an unknown area of science. Because of the importance of the secondary unstable Rare Isotope Beams(RIB) for a “broad programme of research in fundamental nuclear physics and astrophysics, as well as in applications of nuclear science.”, in its roadmap NuPECC recommended the construction of two new-generation complementary RIB facilities in Europe. One based on the in-flight fragmentation (IFF) and the other on isotope-separation on-line (ISOL) method. The IFF method will be part of the FAIR project at GSI. With this method, short-lived radioisotopes of many elements at high energy (1GeV/n) become accessible to experiments. In ISOL method, a thick target is bombarded with a primary proton beam or with a secondary neutron beam in case of fission targets. The produced radioactive nuclei are post-accelerated to low energies (keV to tens of MeV). ISOL method provides, high-intensity beams which are very good with ion optics comparable to stable beams. The next-generation RIB ISOL facility will be realised when the EURISOL facility will be built. EURISOL has recently signed an EU ‘Design Study’ contract within FP6. The initial design will be ready around 2008-2009. A full engineering design study will follow and will lead to the construction and operation of the EURISOL facility around 2020. Because of the time-line for EURISOL, NuPECC recommends the construction of intermediate-generation facilities that will benefit the EURISOL project in terms of R&D and will give the community many opportunities to perform research and applications with RIBs. Among four proposed intermediate facilities for EURISOL, according to NuPPEC roadmap only SPIRALII, which is ready for construction, meets the criteria of European dimension in terms of physics potential, site and size of the investments (total cost estimate around €130 million). FAIR with fast, high energy RIB and SPIRALII with intense and low energy RIB are truly complementary.
4. Impact to society and to new technologies for industry
The accelerator structure based on superconducting RF cavities will be at the forefront of superconducting technologies, which are the basis of developments in accelerators and instrumentation of a large number of new projects (X-Fel, High –energy colliders, Neutron spallation sources). In applied areas SPIRALII is considered as a powerful variable energy neutron source, a must to study the impact of nuclear fission and fusion on material, and to obtain nuclear data for the upcoming GENIV fission and ITER fusion facilities. The intensities of these unstable species are excellent opportunities for new tracers and diagnostics either for solid state, material or for radiobiological science and medicine.
5. Strategic importance to ERA
SPIRALII facility is an essential step towards the long range goal of the European Nuclear Physics community to design and build the ultimate ISOL European facility EURISOL. NuPECC roadmap has examined four candidates for this decisive step and has placed SPIRALII as the top priority among those. SPIRAL II is necessary to maintain European leadership in the field of exotic nuclei. SPIRALII will serve a community of about 600 scientists. This is very competitive domain where Japan has invested more than €500 million in its RIKEN-RIBF facility and where the US is proposing to build an “Rare Isotope Facility “(RIA, €1000 million). It is of the utmost importance that the EU maintains its present leadership and prepares its future in the field with SPIRALII @ GANIL for the low energy domain (10-50 MeV/n) and FAIR @GSI for the high energy complementary branch (1000 MeV/n). SPIRALII will be with its expected performances at the horizon of 2010 a world leading facility.
6. Maturity of proposal (including possible timetable)
The conceptual design and later the technical design of SPIRALII have been developed by more than 20 laboratories from 10 countries from 2001 to 2004 and hundreds of scientists have contributed to the science and technical case. The technical design has reached the point where SPIRALII is ready for construction. The decision is expected early 2005. The investment cost is €95 million and personnel costs €34 million, for the construction period 2005-2010.
7. Budgetary information (preparation, construction and operation costs)
Construction budget (investments) €95 million (2005-2010). Operation costs € 8.5 million per year.

***1. Project:* KM3NeT**
European deep-sea neutrino telescope with a volume of at least one cubic kilometre.
2. Short description of project and main characteristics
KM3NeT will be the only deep-sea neutrino telescope of this size in the world. It is only complemented by the American IceCube project, which has the same scientific aims, but as compared to IceCube (under construction in permanent ice in the Antartic) the European KM3NeT proposal has three advantages: its angular resolution (of 0.2 degree) will be better by a factor of 5, its energy threshold will be better by a factor of 10 (down to 0.1 TeV), and KM3NeT has the major advantage of being able to see neutrinos originating from the galactic centre. These advantages are very important for the potential of KM3NeT to study Dark Matter particles, or –more generally- to study neutrino sources, which will represent the start of neutrino astronomy.
3. Science case (scientific justification, including new areas to be opened)
By measuring neutrinos originating from point sources in the universe, it will be possible to open an entirely new field of astronomy, i.e. neutrino astronomy. For the first time compact astrophysical objects can be studied with neutrinos which do not suffer from galactic magnetic fields, or dust clouds. Such observations will be essential in understanding the mechanism of the most energetic objects in the universe such as Gamma-Ray Bursts, Active Galactic Nuclei and micro-Quasars. Moreover, observation of neutrinos originating from the centre of the galaxy or the sun may enable us to observe –for the first time- the decay of dark matter particles and determine their mass. This will represent a breakthrough, now that it has been found that the mysterious dark matter constitutes some 23% of the energy content of the universe. Finally, the measurement of the diffuse neutrino flux from the cosmos will make it possible to study the unknown origin of cosmic rays (and why they reach such extremely high energies) with an independent probe.
4. Impact to society and to new technologies for industry
KM3NeT has generated interest from marine biologists, as the KM3NeT data provide information on the longterm behaviour of light-emitting life forms inhabiting the bottom of the seas. Such biological studies are –among other subjects- focussed on the impact of these life forms on the CO_2 balance in the oceans. As the operation of the detector involves the generation, transport and storage of huge amounts of data, there is a common interest with groups involved in developing e-science and computer grid technologies.
5. Strategic importance to ERA
The construction and exploitation of a Research Infrastructure of the size of KM3NeT can only take place at the European level. The unique features of KM3NeT will make it the leading instrument in its field (astroparticle physics) in the world. Its governance, legal and funding aspects will represent a unique test case and provide input to national and EU research agencies alike.
6. Maturity of proposal (including possible timetable)
The actual collaboration for this project was formed while preparing the proposal for the EU design study. The design of the infrastructure (as approved by the EU 6^{th} Framework Programme) will begin in 2006, and run for 3 years. Construction can start in 2009 and will take another 3 years. Hence, the operation of the new deep sea neutrino telescope will begin in or shortly after 2012.
7. Budgetary information (preparation, construction and operation costs)
For the design study of KM3NeT a budget of €10 million has been approved by the EU (6^{th} Framework Programme). The construction costs are estimated to be about €200 million. Operational costs have not yet been estimated, but are known to be a very small fraction of the investment costs.

1. *Project:* Extremely Large Telescope (ELT)
2. Short description of project and main characteristics
The current generation of optical large (8-10m) telescopes is expected to produce forefront science until ~2015. Afterwards, a next generation of extremely large (>30m) telescopes will be needed to tackle the most challenging questions in Astronomy such as the Origin of the structures in the Universe and of the Planets. They will complement other observing infrastructures such as the James Web Space Telescope and the ALMA radiointerferometer foreseen near 2012. ELTs require advanced technologies in a number of technical domains. The experience gained with the European Very Large Telescope and its instrumentation is the starting point for future European developments.
3. Science case (scientific justification, including new areas to be opened)
The gain with respect to existing telescopes in terms of sensitivity (factor of 10 for a 30m telescope, factor of 100 for a 100m telescope) and spatial resolution (factor of 3 for a 30m telescope, factor of 10 for a 100m telescope) will be used for the exploration of the frontiers of the Universe and the observation of the "local" objects with an unprecedented sharpness. All fields of Astronomy will benefit from these gains. Formation and early stages of the structuration of the Universe and formation of extrasolar planets and associated search for signs of life are the most challenging science drivers. Related detailed objectives include: - spectroscopic properties of extrasolar planets; statistical studies - stellar populations in the Universe: Star Formation Rate" from Supernovae up to z=10 - first objects in the Universe: high z galaxies (up to z=15)
4. Impact to society and to new technologies for industry
- The understanding of the Universe and of our origin is one of the most appealing scientific topics to society. Astronomy in general is a very good tool to attract people to science in general and physics in particular. - A large number of technical challenges are associated to the ELTs. Among them, the building of huge and very precise opto-mechanical structures (moving the Eiffel tower with an accuracy or 1 arcsec!), the cophasing of the sub-apertures of the telescopes, the adaptive optics systems that will equip those telescopes. All require the use of challenging technologies that are studied both within the laboratories and in the industry. Telescope and instruments will be manufactured primarily in industry.
5. Strategic importance to ERA
ELTs represent the highest priority worldwide for ground based projects in the 2012+ era. The high pressure put by European astronomers on the use of the VLT is a good indication that it will be the same for an ELT. The 4 telescopes of the VLT are the most successful optical telescopes today and host some of the most sophisticated instruments. Europe has the potential to lead the next generation of optical telescopes and to get a huge scientific return in answering the challenging scientific questions listed above.
6. Maturity of proposal (including possible timetable)
Design Studies addressing key technological questions are taking place under FP6 for the ELTs. Other aspects (including science cases) are reviewed in the OPTICON I3. Important steps are scheduled in the two forthcoming years concerning in particular the size of the ELT (this size will be driven by feasibility, cost and calendar issues). Conceptual, preliminary and final designs will be done in the next 5 years (~2005-2010). The length of the realisation phase will depend on the size of the telescope but with a strong preference for a 30m class telescope near 2015, followed by a larger telescope near 2020. The two might be mixed in a single telescope using a concept of a growing telescope with 2 phases.
7. Budgetary information (preparation, construction and operation costs)
The construction cost of an ELT will range from €600 million (30m telescope) to €1 billion (100m telescope).

1. Project: Pan-European Research Infrastructure for Nano-Structures (PRINS)

2. Short description of project and main characteristics

The project aims at constructing a Research Infrastructure (advanced equipment and facilities) to enable European innovative research for the ultimate scaling of electronic components and circuits. The open access of this infrastructure will enable the cross-disciplinary implementation of academic and industrial competencies in the areas of nanoelectronics, nanosystems, nanobiology, nanophotonics etc. To maximize the cost-effectiveness and efficiency of implementation it will build on existing facilities operated by the main European research actors in nanoelectronics research. Special mechanisms will be implemented to facilitate access for the European research community.

3. Science case (scientific justification, including new areas to be opened)

The shrinking size of electronic components is anticipated to continue for another 15 years on the basis of silicon technology. Several disruptive approaches have been explored during the last decade to fabricate novel nanometer-sized functional structures. Some of these alternatives have become known under the generic name of "bottom-up fabrication". In the future, nanotechnology will move towards the *convergence of top-down and bottom-up techniques*. In order to combine both approaches, a dedicated state-of-the-art research infrastructure is needed which will focus on the integration of multiple research fields in the silicon technology such as: materials research and atomic scale characterization, new device concepts, nano-scaled CMOS and post-CMOS processing, processing methods, reliability studies and the integration of such concepts and devices in complex systems.

4. Impact to society and to new technologies for industry

It can be stated that nanotechnology will be the ultimate accomplishment of Moore's law. The impact will be more than this technological achievement as the focus of nanoelectronics will shift from pure scaling-based applications to a wider spread of applications useful for the European citizen such as safety & security, communications, health, environment, mobility, education and entertainment.

5. Strategic importance to ERA

The European nanoelectronics community has established itself as a forerunner through the creation of the European Technology Platform “ENIAC”. However, European academia in nanoelectronics experience difficulties in gaining access to state-of-the-art Research Infrastructures, whose cost cannot be matched by far by the budget of individual academic laboratories. The PRINS approach aims at providing a co-ordinated European answer to this challenge.

6. Maturity of proposal (including possible timetable)

The PRINS proposal is being prepared in line with the Strategic Research Agenda for ENIAC, the executive summary of which will be completed by mid-2005. The general framework of installation comprises *two main phases*:

Phase 1 (2007 – 2010): Research Infrastructure for ultimate silicon processing research infrastructure, for nanometer-scale metrology and characterization, for integration in and above silicon of disruptive structures and for a first demonstration of the “bottom-up fabrication”, while reinforcing the European leadership in equipments and materials.

Phase 2 (2011 – 2013): Research Infrastructure for combination of top-down /bottom-up based nano-fabrication (molecular manipulation, on-chip positioning, control at the nanometer scale) of devices and circuits.

7. Budgetary information (preparation, construction and operation costs)

Phase 1: €600 - €800 million for ultimate silicon research infrastructure; €400 - €600 million for integration of heterogeneous technologies and first-generation nanofabrication tools

Phase 2: €300 million for advanced nanomanufacturing tools.

The infrastructure will be distributed in a complementary mode over a limited number of European sites, involving:
(i) research centres with state-of-the-art device processing and top-down/bottom-up integration capabilities,
(ii) specialized centres for heterogeneous integration of different research fields and
(iii) centres for research on advanced materials and novel device concepts.

Complementary funding will be raised from private sources in a public-private partnership mode.

1. *Project*: European Spallation Source (ESS)
A new generation neutron source for the study of matter.
2. Short description of project and main characteristics
The ESS, highest priority of all major neutron centres and scientists since the early nineties, will be the world's leading neutron source, providing a combination of the highest neutron intensity and novel instruments, to form a unique tool for research into structure, characteristics, functions and dynamics of matter.
3. Science case (scientific justification, including new areas to be opened)
ESS will strongly enhance capabilities for real time, real size, real life, in-situ neutron measurements of both static and dynamic phenomena, including movies of nano-scale events. The neutron's unique probing potential (magnetic moment, observation of hydrogen, penetration, etc.) coupled with the order of magnitude increase in intensity opens the door to dynamics and structural studies in biology and large molecules in solutions (folding of proteins), research into polymers and soft condensed matter, real scale tomography and radiography of engineering materials, solid state physics and chemistry, but also to studies in particle physics using ultra-cold neutrons. Neutrons, light sources, NMR and e.g. electron microscopy are complementary techniques.
4. Impact to society and to new technologies for industry
ESS will be an important and in many cases necessary tool to investigate the ultra-thin and laterally confined structures for e.g. reading devices in the ICT industry, the active site structures in enzymes, technologies for storing hydrogen for a sustainable energy economy, multi-component complex fluids in porous media for tertiary oil production, or the templating of nanostructures for catalysts, medical implants, pharmaceuticals, photonic materials, etc. The need for novel detector, instrument and software technologies will be drivers of innovation.
5. Strategic importance to ERA
ESS, being the pinnacle of a tiered neutron sources landscape, will be the key driver for a vibrant European neutron science community of now 5000 scientists. ESS is necessary to maintain or reclaim Europe's lead in neutron science and technology when the US and Japan will define in the next decade the new competitive edge with their new sources (coming on stream in 2006 and 2007/8). Neutron science is one of the very few areas of acclaimed European leadership.
6. Maturity of proposal (including possible timetable)
15 Labs and organisations from 11 countries and hundreds of scientists have produced the Technical Design and the Science Case. The ESS-Initiative, based at ILL, takes over from the ESS Council to advance the case of a next generation neutron source. At least one government is preparing for decisions during 2005/2006 whether to offer to host ESS. A substantial part of the engineering design and the overall construction planning are ready. Optimising the scope and completing the engineering design, detailed costing and overall construction planning (substantial parts are ready) would require 2 years. Construction will take 8 years. The ESS project has already in a report commissioned by ESFRI received top marks when evaluated amongst other investments in neutron scattering infrastructure with respect to scientific impact and potential, technical risks, cost effectiveness and costs.
7. Budgetary information (preparation, construction and operation costs)
Optimisation scope/design completion: €20 million. Prototyping: €20 million. Construction costs: € 1.5 billion (5 MW short pulse –SP- plus 5 MW long pulse –LP- version), or € 1 billion (5 MW LP version). Operating costs: €140 million (5 MW SP + 5 MW LP, or M€ 80 (5 MW LP). Further investments could be made in extending the LP version to 10-15 MW. Costs are valued in the year 2000.

1. *Project:* **European XFEL**
European X-Ray Laser Facility (X-ray Free Electron Laser)
2. Short description of project and main characteristics
The European XFEL will provide coherent radiation in the hard X-ray regime with pulse durations below 100 fs. The peak brilliance will surpass the best existing storage-ring-based X-ray light sources by 10^9. The light will be generated by electrons accelerated in a 2 km linear accelerator.
3. Science case (scientific justification, including new areas to be opened)
The very short pulse length and the extremely high brilliance of the radiation provided by the European XFEL facility will enable scientists to move from the observation of equilibrium states to the dynamics of (bio-) chemical reactions. "Movies" of such reactions with single atom resolution will be recorded. The X-ray laser opens up completely new opportunities to decipher biological molecules by creating high resolution images from single molecules without the need to grow crystals, as well as for novel studies in materials sciences on nanometer length scales. Hitherto unreachable regimes for plasma physics and other research areas will become accessible.
4. Impact to society and to new technologies for industry
The European XFEL will provide a new tool for many different research fields. The detailed understanding of chemical reactions and of the way molecular machines work will be essential for future drug and material design. The big leaps in brilliance and pulse duration have already triggered the development of novel detector technologies and high power optical lasers which could be expected to be drivers of further innovation. The European XFEL will use a new superconducting technology to accelerate electrons. This technology is expected to be the basis of many future accelerators for free electron lasers, high energy physics, nuclear physics, neutron spallation sources and other applications. With the experience gained with the realization of the XFEL industry, Europe could achieve a world leadership in these technologies.
5. Strategic importance to ERA
With the VUV-FEL user facility constructed within the international TESLA collaboration (55 institutes from 12 countries) at DESY, Hamburg, Europe is currently the world's leading area with respect to free electron laser research. The European XFEL will be essential to keep this leadership and to utilize and apply the breakthroughs expected from research at X-ray free electron lasers. Such lasers will also be constructed in the US and Asia. The experience gained with the application of superconducting accelerator technology at the European XFEL will be crucial for the involvement of Europe's science and industry in future accelerator based large scale research facilities.
6. Maturity of proposal (including possible timetable)
The TESLA collaboration has published a Technical Design Report (2001) and a supplement to it (2002) for a European XFEL facility. A test facility was set up at DESY which very successfully demonstrated the realization of an ultraviolet free electron laser. First user experiments took place and resulted in internationally well-appreciated publications. At present the test facility is being upgraded to the VUV-FEL user facility which will become operational in spring 2005. In 2004, on invitation by the German BMBF, European ministries and funding agencies have formed a Steering Committee to coordinate the efforts towards a European XFEL. The construction of the facility is expected to start in 2006 and last six years.
7. Budgetary information (preparation, construction and operation costs)
The full costs for the preparation and construction of the European XFEL are at present estimated to be €738 million (year 2003 prices). Germany has offered to take over 60% of these costs. The yearly operational costs will amount to €70 million (year 2003 price).

1. Project: IRUVX-FELs
A Trans European Network of complementary Infrared to Soft-X ray Free Electron Laser Laboratories for Nanoscience and Technology.
2. Short description of project and main characteristics
The development and construction of a network of high brilliance short pulse Free Electron Lasers operating in the Infrared to Soft Xray wavelengths (down to about 1 nanometer or 1000 eV) is now possible, thanks to recent advances in the generation of high charge-short pulse electron bunches. Several technical approaches allow the production of beams optimized for different applications (highest brilliance, duty cycles, synchronization, etc.) and catering to different scientific requirements of users. At present two projects are being developed and a few others are under design and technological development, with all involved teams interacting at EU level. The development of these projects as an integrated Trans European Network will give Europe an overall infrastructure of world level quality, including present Synchrotron Light and “table top” Lasers.
3. Science case (scientific justification, including new areas to be opened)
The present number of users of Synchrotron Light in Europe is about 10 000, and the potential users interested in light-based techniques ranging from microscopy to hotolithography are about 100 000. The introduction of sources generating femtosecond flashes up to one billion times more brilliant than present synchrotron sources allow the spectroscopy and microscopy of dynamical phenomena in any material as well as ablation hotolithography. This will open new important areas in the study of materials and plasmas, and allow the study of very small or dilute systems with unprecedented definition. The interval Infrared to soft Xrays covers the largest part of physico-chemical phenomena. Each source will serve a limited number of measuring stations (up to about 10) and a maximum of 500 users a year. The network allows a sizeable fraction of users to be covered.
4. Impact to society and to new technologies for industry
The advancement of Materials, Biomaterials and Nano S&T has been at the base of the most-long lasting and effective industrial growth in the past century, and this area is the major mover in the growth of new economic and environmental-friendly applications ranging from ICT to Medicine.
5. Strategic importance to ERA
The competitivity of European Science as well as of Industry is directly connected to the ongoing competitivity in the research fields listed in point 4.
6. Maturity of proposal (including possible timetable)
Two nodes of the network are already being developed, and decisions on the other nodes are expected in the next two years. The overall network could be realized in the next 10-15 years.
7. Budgetary information (preparation, construction and operation costs)
The construction costs for each node can be estimated between about €150 and €200 million. Assuming a final network of seven laboratories (comparable to the present network of 3rd generation synchrotrons), the total cost will be between €1000 and €1400 million in 15 years, mainly from national resources. The EU contribution could be between 10 and 20 % of the total, aiming at opening the construction and use of the network to all EU countries. Running costs can be estimated to less than 10% of the overall investment costs, taking into account possible synergies with several of the existing SR laboratories where the FELs will be sited. The Trieste site is built on a project financing based on State, Regional and EIB financing, and the Government of Italy has proposed to other interested countries to participate, on the basis of the development of a common European Network.

1. *Project:* A Light for Europe: European Synchrotron Radiation Facility (ESRF)
An upgrade programme for the ESRF to provide unprecedented scientific opportunities for Europe's scientists.
2. Short description of project and main characteristics
The ESRF is recognised as the world's most innovative and productive synchrotron radiation (SR) X-ray source, providing world-leading experimental facilities to the European scientific community. Advances in fields such as X-ray optics, detectors and accelerator physics, many of which originated at the ESRF, now allow an ambitious renewal programme covering all aspects of the ESRF's activities. Performance will be enhanced by several orders of magnitude. New scientific areas will be addressed with new highly specialised nanofocus beamlines, with even brighter "hard" X-ray beams, and by renewing beamline components (detectors, optics, sample environments and sample positioning). Special attention will be paid to the development of advanced imaging techniques.
3. Science case (scientific justification, including new areas to be opened)
The much improved scientific capabilities of the ESRF will be exploited in four broad scientific areas: **Nanoscience and Nanotechnology**. The ESRF is an essential tool for structural and dynamic investigation at the truly microscopic (Å→nm) level and has opened up many new areas of study in biology, chemistry, environmental sciences, materials science, medicine and physics, notably by its provision of brilliant and stable micrometer size X-ray beams. Based on recent ESRF advances, the optimisation of all X-ray beamline components and beam optics will allow X-ray beams down to 20 nanometres to be used routinely, opening up new scientific areas (e.g.) of innovative "designed" nano-materials, the fertile interdisciplinary area of soft matter/biological materials, and nano-scale electronic/spintronic components. **Pump-Probe experiments.** ESRF has pioneered time-resolved diffraction studies on biological systems and chemical bonding. These world-leading investigations exploit the time structure (down to ~100 ps) of special storage ring operation modes. These studies will explode in importance when the new X-ray lasers (FEL) become available. Instrument optimisation and new beamline design at the ESRF will permit both diffraction and spectroscopic investigations, setting the scene for sub-picosecond FEL science in the decades after 2010. **Science at extreme conditions.** New domains of materials science will be opened up by new beamlines dedicated to diffraction and spectroscopy at extremes of temperature (milli-Kelvin to 5000K), pressure (up to 5 Mbar) and magnetic field (up to 50T, constant and pulsed). Geology and geophysics (of the earth and planets) will benefit from this new information on structure, dynamics and electronic and magnetic properties. **Structural and Functional Biology.** The current revolution in biology, as interest shifts from structure to function, will continue to require extremely detailed structural information on increasingly 'difficult" samples, exemplified by membrane proteins. New highly automated nanofocus beamlines with high throughput capabilities will be provided for the screening and measurement of such crystals. **Instrumentation development** programmes will underpin these scientific advances. Detector development is of major importance to the ESRF but also to all of Europe's SR sources; detectors are generally recognised as the "weak link" in the modern use of SR. Developments in partnership with European centres must be focused on large area detectors (innovative pixel detectors, silicon drift-diodes and avalanche photo diodes).
4. Impact to society and to new technologies for industry
Synchrotron radiation is one of the most generally useful of society's scientific tools and provides new knowledge and understanding of a remarkably wide range of materials at the microscopic (atomic and molecular) level. The unique microscopic information that SR can alone supply is essential for the competitiveness of tomorrow's industry in Europe, in fields such as drug design and pharmaceuticals, catalysis, advanced materials and advanced analysis.
5. Strategic importance to ERA
This renewal programme will further reinforce the ESRF's position as the world's leading hard X-ray facility and will strengthen the complementarity with the excellent new national SR facilities. The partnership between the ESRF and these lower-energy sources and with the growing number of FEL sources across Europe will maintain Europe's world-leading position in essential fields of ever increasing technological importance. The renewal programme will be accompanied by the creation of scientific partnerships, modelled on the Partnership for Structural Biology, in fields such as Soft Condensed Matter and Materials Science.
6. Maturity of proposal (including possible timetable)
This renewal programme has been discussed and refined by the ESRF Science Advisory Committee and Council, and the annual Users' Meeting, as well as by the ESRF's own SR scientists.
7. Budgetary information (preparation, construction and operation costs)
The full renewal programme foreseen for the ESRF will amount to some €200 million. The programme could start in 2007 and stretch over five years.

1. Project: **HPCEUR (High performance computing for Europe)**
A sustainable computer facility and service providing European scientists with world class capabilities.
2. Short description of project and main characteristics
The project will provide a sustainable permanent infrastructure and service enabling world class computer simulations for leading edge scientific and technological projects. The necessity of a European level service, complementing national and thematic resources, is a result of the technological trend and of the deliberate positioning of very large facilities in Japan and the USA well above configurations made available in response to market requirements. The definition of a service rather than a bare infrastructure stems from two requirements. Firstly usage duration will span several computer implementations caused by the progress of technology; the project will deal with equipment evolution and renewal. Secondly, this takes care of all environmental requirements: large-scale storage, networking, access grid, data visualisation as well as project assistance in parallel computing and algorithms. In its starting phase, the project will rely on the achievement performed by the DEISA cluster project, linking the leading national supercomputing centres in Europe. In a later stage, the distributed computing infrastructure will be upgraded to reach the petaflop capacity and beyond.
3. Science case (scientific justification, including new areas to be opened)
Supercomputers enable scientists and engineers to deal with otherwise intractable problems, using an approach where a theoretical model of the physical world, a computational approximation and an algorithmic implementation play key roles. The necessity of such an approach may come from the problem or solution complexity (turbulence and combustion), the infeasibility of an experimental approach (climate modelling, earthquakes), the shear size of the relevant information (computational biology). World class facilities provide a competitive advantage by enabling real time applications (meteorology), fast enough solution time to fit in a creative and productive research or engineering process. Areas where European scientists will benefit most from access to a world class facility include: material science, nano-sciences and technologies, climate modelling and the prevention of weather related risks, earth sciences and earthquake risk mitigation, plasma physics and research to make fusion energy practical, bioinformatics and computational biology, fluid dynamics and combustion processes.
4. Impact to society and to new technologies for industry
The project will improve the understanding and facilitate research and innovation in the areas delineated above. An enhanced decision process with respect to natural and environmental risks and issues has certainly an immense value for society and decision-makers. Similar grand challenges are related to energy, medicine and therapy, engineering etc. Industry will benefit from a more thorough understanding of proposed devices and processes, the possibility of design optimisation and risk mitigation.
5. Strategic importance to ERA
It is required to provide European scientists and engineers with world class capabilities. This will enable them to benefit from enhanced understanding of phenomena, select the most appropriate research strategies. This will greatly enhance the credibility, attractiveness and efficiency of the ERA and reduce the brain drain caused by inadequate access to state-of-the art facilities. Improving the transfer of scientific and technological knowledge into industrial products and processes is certainly a major objective of the ERA. The project will contribute as described above, and also in enhancing the ERA's ability to capitalize the know-how into databases and computer simulation programs. Finally, the project will also structure the leading computing resources to be operated in a coordinated and collaborative way.
6. Maturity of proposal (including possible timetable)
The urgency and scope of the issue of a European computing infrastructure has been totally changed recently with the dramatic increase of the effort in Japan and the USA. In order to deal with the new challenge in a responsive way, it is important to build on existing projects and initiatives: thematic proposal by the "Climate Research" community, projects EGEE and DEISA, national super computing infrastructure, etc. The first DEISA project is currently running and will apply for extension in the next infrastructure call of the current 6 Framework Programme. n the medium and long-term future, the following major aspects have to be considered and potentially addressed: 1) The networking infrastructure across Europe to interconnect the national supercomputing centres should be based on dedicated lambda rail connection for the efficient operation of the joint HPCC Infrastructure. 2) It is foreseeable that the major European countries (Germany, UK, France, Italy, Spain, etc) will support national supercomputing infrastructures coordinated upgrades capable of hundreds and later thousands teraflops of peak performance. A joint proposal is under study by France, Germany and the UK to define a coordinated European strategy and a relevant project. It is commonly understood is that a two-step process is required: establishment of an ERA-Net in 2006, launch of the full size project in 2009.
7. Budgetary information (preparation, construction and operation costs)
The continued operation of the project will require an investment of €250 million, to be renewed every 2 or 3 years. Related operating costs, even if not part of the investment for a Research Infrastructure is indicated as between €40 and €60 million.

1. Project: **New medium-size (coastal) multipurpose research vessel for the Baltic Sea**
2. Short description of project and main characteristics
The project aims at building/purchasing a new multipurpose research vessel to be used jointly by the new EU Member States in the Baltic Sea region. The medium-size vessel is planned to able to perform diverse research tasks, including various water and sediment sampling, high resolution 'on line' measurements, deploying 'in situ' scientific instruments, fisheries research, etc.
3. Science case (scientific justification, including new areas to be opened)
Modern oceanography is based on three major methodical columns: numerical modelling, remote sensing and *in situ* data collection. The latter being still the most important as, through model validation and ground-truth data, it provides the necessary basis for the other two, more recent scientific methods. Besides continuously improved equipment, instrumentation, data management and laboratory facilities in marine sciences high-tech research vessels play a key role in providing the means for obtaining high quality data. This applies for all research fields and levels and in all seas around the world. The Baltic Sea as an ecosystem in particular is facing threats through eutrophication from intensive agricultural use within the drainage area, contaminant loading from industrial activities, overexploitation of fish stocks and invasive species.
4. Impact to society and to new technologies for industry
The new research vessel will allow: • full participation of marine scientists in the new EU member states through *in situ* data collection, analysis and research within the Baltic Sea Regional Project (BSRP) • equal position of all Baltic Sea countries in future 'Marine Research Facilites Exchange Group' • improvement of monitoring and assessment of the environmental status of the Baltic Sea according to HELCOM • improvement of the quality of the fish stock assessments in the Baltic Sea
5. Strategic importance to ERA
The project has strategic importance to ERA because: • several recent European strategic fora (ESFRI, CREST) have emphasised marine research as a field where major synergistic benefits can be reached by improving the coordination of research and infrastructure investments. • a strong emphasis has been put on integrating the new Baltic Member States, including Russia, in the European Research Area. • the inventory of research vessel capacity in the Baltic Sea region clearly shows that in the southeastern part of the Baltic Sea there are only few small vessels available to cover monitoring and research needs in this area. • the need for a new research vessel for the Baltic Sea has been documented by the European Science Foundation Marine Board in its recent meeting. • the initiative is supported by the European Fisheries and Aquaculture Research Organisations EFARO-Baltic group.
6. Maturity of proposal (including possible timetable)
Preliminary time schedule of the project is: • 2004: proposal agreed by the Network Steering Committee of the ERA-NET BONUS for the Baltic Sea Science – Network of Funding Agencies (www.bonusportal.org) • 2006: detailed investigation on the structural & scientific needs and costs, sources of funding, including the EU and the partner countries. • 2007: agreement and decision on implementation. Start of the implementation. • 2011: new ship starts its operation • At least one new Baltic EU Member State, alone or as a partner in a common enterprise, declared to be willing to run the vessel and cover operation costs.
7. Budgetary information (preparation, construction and operation costs)
€20-€25 million for preparation and construction.

1. *Project:* Research Icebreaker AURORA BOREALIS
A novel research icebreaker with drilling capability.
2. Short description of project and main characteristics
AURORA BOREALIS will be a novel research icebreaker (Length:132 m; displacement: 23,000 tons) with no national or international competitor because of its drilling capability in up to 4 km water depth with seafloor penetration into up to 1 km, its sophisticated modularized mobile laboratory systems for multiple polar science disciplines: meteorology, glaciology, oceanography, biology, geology, and geophysics as well as marine technology, its moon pools for drilling and for the deployment of Remotely Operated Vehicles (ROV) and Autonomous Underwater Vehicles (AUV) for sub-ice surveys, its propulsion and dynamic positioning systems and its capability for Arctic expeditions also during the unfavourable seasons of the year.
3. Science case (scientific justification, including new areas to be opened)
Polar research in high latitude oceans are currently a subject of intense scientific and environmental debate, because they are and have been over historic geologic time scales subject to rapid and dramatic change reacting more rapidly and intensively than other regions. Until now it is not clear, whether the profound change in all parts of the Arctic is a natural fluctuation or is due to human activity. Since this change is a phenomenon of decades, long time data series are needed for its understanding and prediction of its further development.
4. Impact to society and to new technologies for industry
European nations have a particular interest in understanding the Arctic environment with its potential for change because highly industrialized countries reach into high northern latitudes and Europe is under the steady influence of, and is in exchange with, the Arctic environment. In addition considerable living and non-living resources are found in the Arctic Ocean, its deep-sea basins and their adjacent continental margins.
5. Strategic importance to ERA
The AURORA BOREALIS has a proposed drilling capability that fulfils the needs of the Integrated Ocean Drilling Program (IODP) for an "Alternate Platform" to drill in deep, ice-covered basins requiring 3-4 months of ship time annually, at least for a decade. Ship time which is not used for drilling, will be made available to other polar research disciplines. Therefore, it will promote the continuity and enlargement of European polar research programs and secure Europe's position in promoting both IODP and Arctic research.
6. Maturity of proposal (including possible timetable)
A science perspective of the AURORA BOREALIS project has been established by an international working group with members nominated by the members of the ESF European Polar Board and JEODI. The published version of the science perspective has been issued by ESF in 2004 and been sent to the ESF member institutions. An Arctic site survey strategy has been published in late 2004 based on a JEODI funded workshop. Technical design studies are available from HSVA and from the Applied University Bremen (with substantial inputs from foreign partners).
7. Budgetary information (preparation, construction and operation costs)
Current estimates for construction costs are approximately €250 million with an annual operation cost of approx €10-€15 million. A shared system between the consortium of implementation countries and international partners would be the best way forward. Contributions from the European Commission and IODP to support science and operational costs would also be required.

1. *Project:* EUROPEAN MULTIDISCIPLINARY SEAFLOOR OBSERVATORY : EMSO
Long-term monitoring of the ocean margin environment around Europe.
2. Short description of project and main characteristics
The scientific need for long time series of data coming from the seafloor at key provinces around European margins providing continuous vigilance in relation to geophysical, biogeochemical, oceanographic and biological active phenomena, is now demonstrated in several disciplines. This refers to the need to establish long-term monitoring of environmental processes which can be related to ecosystem life and evolution, global changes and geohazards. These observatories, including relocatable systems, will be deployed on specific sites characterised by active processes and be linked in a network at European level.
3. Science case (scientific justification, including new areas to be opened)
The ocean covers 71% of planet earth; at least 40 % of the EU territory is underwater. The understanding of this “hidden world” requires a better exploration of new frontiers. Major advances in our understanding of the oceans require the measurement of cyclic changes and to capture episodic events relative to deep-sea processes and ecosystems. Seafloor instrumentation is needed to acquire simultaneously long time series of data relative to: seismology, geodesy, sea level, gas vents, physical oceanography, biodiversity imaging at several scales, particle dynamics, slope failure, turbitidy currents, pollution, etc. Most of these processes interact and should be measured for modelling and forecasting natural events. A network will strongly improve the way of safeguarding and using data related to these environmental changes.
4. Impact to society and to new technologies for industry
A network of seafloor observatories is fundamental for the GMES system as a sub-sea segment. The network may contribute to warning of short and medium hazard events (e.g. tsunamis, sub-sea landslides, gas leakage, pollution from ship wrecks). This vision is essential for decision-makers to set up effective strategies for risk and security management. The data can be considered as significant outputs regarding the sustainable use of marine resources. The development of new technologies, including standards on sub-sea equipment, must be considered as a new challenge for European industry.
5. Strategic importance to ERA
Establishing a network of seafloor observatories requires the fulfilment of the critical mass at European level, overcoming national fragmentation. The network development shall be based on synergic collaboration between the academic community and that of industry (technology). This synergy allows each partner to increase its own know-how, to improve marine technologing and to set strategies to be competitive with countries such as the USA and Japan. The question of integration in a global network may arise.
6. Maturity of proposal (including possible timetable)
Through the concerted action of ESONET and an existing fleet of seafloor observatories (GEOSTAR, ASSEM, etc), this community has matured and is ready to establish an observatory network to be integrated with on-land and satellite networks, as envisaged in GMES.
7. Budgetary information (preparation, construction and operation costs)
The estimated budget depends on the number of areas monitored by the sub-sea observatories. Using the conclusions of ESONET thematic project, 10 regions around Europe have strong scientific reasons to be monitored. Total cabled length is 4000 km. Preparation, preliminary scientific studies and design costs: 27 M€. Construction (10 regional networks): €37 million. Yearly maintenance: €13 million. Life of the equipment: 20-25 years.

1. *Project:* European infrastructure for research in and protection of biodiversity
2. Short description of project and main characteristics
The proposed infrastructure will be the first global centre for databases analogous to the bioinformatics (genomic, protein and macromolecular structure) databases. The latter are today a globally indispensable facility for biomedical sciences. Similar databases for species of organisms do not exist. The proposed infrastructure will store and manage data on biological species, namely data on the geographical distribution, migrations and ecology of species, on available specimens in public collections and on valid taxon names and phylogenetic relationships. These data will be linked with available genomic resources. The infrastructure will also actively develop new tools for fast biodiversity assessment, such as electronic interactive determination systems and automatic species identification based on DNA sequence data (DNA taxonomy), using and developing the tools of modern biotechnology. Due attention will be addressed to species-rich geographic areas, in Europe and the tropics.
3. Science case (scientific justification, including new areas to be opened)
Species data originate from research and inventorying in natural history museums, in university institutes and from single research projects. They are scattered over thousands of publications which are difficult to access especially in those countries that harbour the highest species richness. Museums of natural history are extremely burdened with the very urgent task of inventorying the world's biological species diversity and do not have the capacity to pool and manage this wealth of information. The proposed infrastructure will do this for a very large international community of biologists, ecologists, farmers, fishermen and policy-makers and will become a resource equally important to the biomolecular databases. To develop and implement DNA taxonomy in a laboratory equipped with modern tools of biotechnology and bioinformatics would speed up inventorying of biological diversity and open new opportunities for ecological research that is hindered by the lack of taxonomists (specialists that identify species).
4. Impact to society and to new technologies for industry
The infrastructure is urgently needed to speed up the inventorying and managing of the world's species richness. A comprehensive species identification in rich habitats is impossible today, therefore ecological studies are superficial and species counts are mostly deficient approximations. We cannot wait longer because the loss of diversity is advancing rapidly and human factories cannot replace what we are losing. This infrastructure will allow a quantum leap in biodiversity research and nature conservation and will support all industrial branches that need biological data (pharmaceutics, parasitology, agriculture, pest control, fisheries). Outsourcing of the production of 'species chips' used for special applications will be a by-product.
5. Strategic importance to ERA
This infrastructure would give Europe a top responsibility for the management of biological data at the organism level and beyond, and would be the leading centre for information on the species that inhabit our planet.
6. Maturity of proposal (including possible timetable)
The necessary tools (bioinformatics systems, species data banks, techniques for DNA taxonomy) already exist. They have been developed without coordination and without perspectives for a sustainable infrastructure due to lack of resources. Concepts have been developed in several European museums of natural history and are ready to be realised. The infrastructure should be located in a place where a large university and a prestigious natural history collection exist. There are several alternatives in Europe that offer the required logistics and the scientific expertise.
7. Budgetary information (preparation, construction and operation costs)
For construction and first equipment €100 million are needed, and upgrades plus networking will require €4 million per year.

1. *Project:* **Advanced infrastructure for brain and whole body imaging**
2. Short description of project and main characteristics
European state-of-the-art imaging facilities will be developed or enhanced for non-invasive functional, metabolic, and molecular imaging from humans to small animals. Potential approaches will include magnetic resonance imaging (MRI), magnetic resonance spectroscopy (MRS), computed tomography (CT), positron emission tomography (PET), single photon emission computed tomography (SPECT), functional nuclear magnetic resonance imaging (fNMR) and very high field NMR for small animal imaging. A link with rapidly developing technologies that bridge resolution gaps and permit dynamic imaging at the cellular level will be made when appropriate. The network of physical image acquisition centres for clinical and experimental studies will be combined with a virtual image management and analysis network. Data will have to be gathered and analysed with regard to the particular patient or experiment, but also with regard to integration into comprehensive image databases. Functional imaging of the human brain will be an important task. Neuroimaging will be combined with genotypic and phenotypic analysis of behavioural responses to allow neurological and psychiatric studies. Imaging of other organs and tissues will allow close correlation with disease states and their molecular underpinning.
3. Science case (scientific justification, including new areas to be opened)
Biological imaging at multiple scales and resolution is of major importance for both basic biology and the medical sciences, including diagnosis and treatment. Non-invasive localisation and quantification of in vivo molecular processes related to human disease, and to animal models of human disease, are invaluable tools for medical research. Thus, reinforcing the European infrastructure for both brain and whole body imaging will have major implications for health care, as well as for improving our understanding of human cognition. Understanding how the human brain works is one of the main challenges of the 21^{st} century.
4. Impact to society and to new technologies for industry
The development of novel non-invasive diagnostic and therapeutic strategies (refined methods of staging, grading and therapy control) strongly relies on the advancement and validation of innovative methods of morphological, functional and molecular imaging. This will improve disease characterisation, individualise treatment and reduce side effects. The development of new technologies in medical and biological imaging has major potential for private-public partnerships.
5. Strategic importance to ERA
Imaging infrastructures and research are already partly developed across Europe, and links are being made on the European level. Existing and new centres will need to be organised as multi-user European facilities, and to provide access in a coordinated way. A virtual infrastructure will store data acquired and analysed across Europe in centrally maintained data resources, which will add substantial value.
6. Maturity of proposal (including possible timetable)
There are several major existing facilities in Europe, which could be rapidly expanded by the acquisition of a wide range of up-to-date imaging equipment, permitting prioritised use by the European scientific community. The diverse facilities will be linked by database image processing.
7. Budgetary information (preparation, construction and operation costs)
Depending on the number of distributed sites, the start-up costs will be in the order of €160 million, with equipment improvements and operating costs per year totalling €120 million. Therefore the total cost for a seven year period is estimated to be €1 billion.

1. Project: Bio-informatics infrastructure for Europe

2. Short description of project and main characteristics

The world's body of bioinformatics data is a critical input for all biomedical sciences and related industries. The proposed infrastructure will ensure free provision of this essential input to the entire scientific community. It will encompass an interlinked collection of robust and well-structured core databases, capable of accommodating the ongoing massive accumulation and diversification of data, and will permit the integration of diverse information that is essential to generate and utilise biomedical knowledge. This infrastructure will also encompass the corresponding major computer infrastructure, a wide range of novel software and experiment-planning tools, and a sophisticated but user-friendly portal to provide services across Europe. It will be embedded in a database-related research programme that permits the development of critically important standards and novel information resources. It will also link to distributed organism-specific knowledge resources and, as appropriate, to speciality and emerging databases of wide interest (e.g. proteomics). It will represent a secure but rapidly evolving platform for data collection, storage, dissemination and utilisation, consistent with the unique requirements of shared resources in the life sciences.

3. Science case (scientific justification, including new areas to be opened)

Bioinformatics resources are and will remain a universal requirement for the life sciences, even more so in the current era of genomics, proteomics and other high-throughput (HTP) biology, which is leading towards a new revolution in systems biology. Databases are typically the only record of HTP science, and are irreplaceable for accessing the entire, rapidly evolving corpus of biomolecular information, from the molecular to the organismic level. New categories of data are emerging, e.g. three dimensional dynamic images, HTP mass spectrometric proteome identification, phenotypic and physiological data, polymorphism and chemigenomic data. Linking standardised information from biobank collections with medical records will be of major importance for medical and pharmaceutical developments. It can be predicted with confidence that, within a decade, the bioinformatics requirements will exceed the computational requirements of the physical sciences.

4. Impact to society and to new technologies for industry

The envisioned infrastructure for biomedical data is crucially important to academic and commercial research, including basic biology, medicine, pharmaceutical, agricultural, nutritional and environmental science. By boldly developing, upgrading or linking the proposed data resources, Europe is capable of establishing infrastructure facilities second to none which, together with ancillary research and training, will enable Europe-wide, world-leading biomedical research and industrial development. Major life science projects are ongoing through private sector, Member State and EC funding. Bioinformatics represents one of the largest leverage factors, by permitting full use of data that collectively are costing many billion euro. Such an integrated bioinformatics infrastructure would be a key contribution to the achievement of the Lisbon objectives.

5. Strategic importance to ERA

The estimated virtual access to this infrastructure in the early years of its development is two or more million website requests per day. Use of the web services is expected from ca. 400,000 unique sites per month. Many of the data resources are embedded in tri-continental collaborations for data exchange and free access, further leveraging the scope of the provided information.

6. Maturity of proposal (including possible timetable)

The proposal has been fully developed conceptually and costed in conjunction with major bio-informatics date resources worldwide.

7. Budgetary information (preparation, construction and operation costs)

An evolving infrastructure of the proper scope, consisting of a major central facility (70%), and medium scale collaborating centres (30%), would require funding of approximately €600 million over 7 years. EC contributions of 30% of the total would be €30 million for construction in the first year and €25 million for upgrades and networking in each of 6 subsequent years.

1. *Project:* European network of advanced clinical research centres
2. Short description of project and main characteristics
Clinical research centres (CRCs) implanted in the environment of major hospitals can act as competence centres, offering investigators access to advanced methodologies and research infrastructures dedicated to clinical investigation, in any field of medicine including health physiology, pathophysiology and therapeutics. CRCs promote translational research from basic findings into diagnostic and therapeutic applications. They provide logistic support to biomedical research through coordination of studies, quality management, data monitoring, dissemination of good clinical practice, database management and data analysis. Infrastructures are necessary *inter alia* for the production of clinical grade vectors for gene and cellular therapy and for new potential therapeutic agents. The aim is to upgrade existing CRCs as well as to create new suitable centres. Laboratories are needed that are compliant with Good Manufacturing practice.
3. Science case (scientific justification, including new areas to be opened)
Reinforcing clinical research and translation of basic research to therapy and public health is a major issue for Europe. The attractiveness of Europe in this highly competitive field is dependent on establishing a continuum from innovative therapeutic agent production to phase I/II clinical trials. The aim is to develop the infrastructure that will permit harmonisation of tools and practice, collaboration and communication between CRCs, optimise the quality and efficiency of research carried out in CRCs, and define shared research topics and strategies. The network of advanced clinical centres will aim to overcome the fragmented organisation of European clinical research and will greatly facilitate meaningful clinical trials. An integrated infrastructure for translational research will play on a European strength, cooperation between research centres. In addition, a centralised platform for data management, data processing and trial monitoring will promote translational clinical studies, with guidelines on methodology, shared tools and procedures.
4. Impact to society and to new technologies for industry
Clinical trials are essential for the development of new medicines in Europe. By linking and upgrading clinical research centres, Europe is capable not only of competing, but of establishing world class facilities, enabling research and industrial development that is more efficient and innovative. They will make the best use of research and pharmaceutical development spending.
5. Strategic importance to ERA
The health industry is one of the fastest growing markets worldwide. Close cooperation between academic institutions and the health sector industry will be key for competitiveness. The facilities for the production of new innovative therapeutic agents will integrate their activity in a network that will be coordinated together with private partners. Europe has an excellent research base and can build on existing collaborations to improve quality and efficiency, to promote harmonisation and to reduce fragmentation of clinical research in Europe which could be extended into a pan-European network.
6. Maturity of proposal (including possible timetable)
The infrastructure would be built by integrating national facilities, expanding the network with new facilities for research, production and clinical trials and by adding central resources like a telematic platform and GMP facilities.
7. Budgetary information (preparation, construction and operation costs)
The construction and equipment of five facilities for clinical vector production will cost €20 million. The construction of two European centres with research laboratories and CRC will cost €16 million. Major upgrading of 10 existing European CRCs and the implementation of a telematic centralised platform will cost €10 million. Overall cost will be €46 million.

1. *Project:* European network of bio-banks and genomic resources – biological resource centres
2. Short description of project and main characteristics
This network of bio-banks and genomic resources (both human and animal / plant / microbial) will encompass collections of samples and reagents that are stored in decentralised facilities. These will be connected by a virtual network that allows central access to these resources. The establishment of common standards and quality management will ensure broad usage in basic and applied research including research of complex diseases. The resources will need to be linked to appropriate bioinformatics databases. Provision of access to the resources would be done in full recognition of key IPR, economic and ethical issues. The resources should also meet the OECD definition and be compliant with appropriate national laws, regulations and policies. Infrastructure will consist of central cataloguing and order handling facilities, based on major existing sites, with fully linked upgraded sites at various medium size facilities around Europe, and by upgrading all sites to be fully interactive with bioinformatics cataloguing and experimental procedures.
3. Science case (scientific justification, including new areas to be opened)
The infrastructure will ensure that the growing body of biological material is easily and uniformly accessible on an appropriate basis to pertinent sectors of the medical and biological research communities in the fields of health, agriculture and the environment, in ways that promote scientific progress and competitiveness. A critical element will be linkage of human tissue samples to high quality medical records with due protection of patients' confidentiality. Other collections will include cDNA and RNAi resources, expression constructs, antibodies, small molecule libraries and other reagents, as well as samples from model organisms. The resources will be of strategic importance to the identification of genes vital to the development of health-related biotechnologies, diagnostic applications and the quest for new therapeutic targets and drugs, and to the conservation of biodiversity along criteria of quality assurance and traceability in order to satisfy future needs that are difficult to predict today.
4. Impact to society and to new technologies for industry
Biobank infrastructures are essential for proper functioning of the biomedical sciences and for taking advantage of Europe's well-organised health systems. By linking and upgrading existing resources, Europe is capable not only of competing, but of establishing world class facilities with abilities far outstripping rivals, and enabling research and industrial development that is not only more efficient, but allows whole new fields and ways of doing research.
5. Strategic importance to ERA
Biobank resource infrastructures and research are partly developed at a European level, but considerable improvement is possible. Creating such a European infrastructure should favour the attractiveness of Europe for the development of biotechnology and the pharmaceutical industry; the creation of innovative SMEs, and the public perception of biotechnology.
6. Maturity of proposal (including possible timetable)
There are already major proposals developed for linking biological resources Europe-wide.
7. Budgetary information (preparation, construction and operation costs)
The estimated cost for construction and ongoing upgrades of a European bio-bank exclusively for human samples is estimated to be €200 million over 5 years. Costs for bio-banks of other species will vary depending on storage conditions and other factors.

1. Project: **High security laboratories for emerging and zoonotic diseases and threats to public health**
2. Short description of project and main characteristics
Creating and reinforcing a European network of L3 and L4 high security laboratories for European infectious disease research.
3. Science case (scientific justification, including new areas to be opened)
Global infectious diseases including HIV, tuberculosis, malaria, leischmaniasis, SARS, BSE, foot and mouth disease and viral haemorrhagic fevers such as Ebola and others are a major burden on socio-economic development in the South, and through migration and global travel increasingly threaten the population of Europe as well. Recent crises have shown that infectious diseases are far from being eradicated in humans as well as animals. One of the key issues to address in order to protect human health is the boundary between human and animal pathogens. The scientific challenges are enormous but the biotechnological revolution allows for important breakthroughs to be made. Diagnosis, surveillance and research of such diseases and their agents require high-security laboratories (containment level L3 and L4).
4. Impact to society and to new technologies for industry
The health sector is one of the main economic sectors and large investments are made to fight diseases on a global scale. Infectious disease control is the main challenge and there is a continuous need for new drugs, vaccines, and diagnostics. Substantial developments based on basic and applied research can be expected.
5. Strategic importance to ERA
The safety and quality regulations for these high security laboratories have become ever more restrictive and require very large investments. National European efforts remain fragmented and diverse, in size as well as in quality. A European coordinated network of high-security multi-species facilities, harmonisation and coordination would greatly reinforce the European capacity. Europe is strong in this area of health research and needs a concerted effort to provide excellent and safe facilities for the European research community.
6. Maturity of proposal (including possible timetable)
First draft to be further developed through existing institutional networks.
7. Budgetary information (preparation, construction and operation costs)
The construction costs for one facility with L3 and L4 capacities is in the order of €22 million. Equipment upgrades are estimated as €1 million per year.

1. *Project:* Infrastructure for functional analysis of a whole model mammalian genome
2. Short description of project and main characteristics
The fields of functional genomics, medically-related life sciences and systems biology already benefit from the usage of the mouse as a model system. In the coming decade, saturation mutagenesis (including conditional mutations) in the mouse will be one of the major tasks of the scientific community and will require a dramatic change in the way of phenotyping and characterisation of mouse models. A European infrastructure will be established for large-scale and comprehensive phenotyping of mouse models. It will be embedded in a global effort to standardise and optimise the phenotypic characterisation of medically relevant models.
3. Science case (scientific justification, including new areas to be opened)
First results from the "Mouse Clinics" show clearly that many phenotypic alterations in mutant animals have been overlooked. Comprehensive phenotyping allows discovery of new phenotypic alterations, which were previously not seen in the initial characterisation on almost every tested "knock out" mouse line. It is now time to organise a European phenotyping platform, which will give access to comprehensive phenotyping to every lab working on the characterisation of mouse models. A single country alone will not be able to handle the demand for phenotypic characterisation - for this reason a concerted effort within Europe is necessary The models are required to decipher conserved molecular mechanisms underlying disease and health. It can be envisioned that within the next decade over 25000 new mouse models will be generated in Europe. This large number is necessary to get access to functional and molecular information on as many genes and genetic elements as possible. To make full use of this resource it is a prerequisite to organise a major phenotyping infrastructure and to include the latest in vivo imaging technologies. This infrastructure could also be adapted in due course, for use with rats.
4. Impact to society and to new technologies for industry
The infrastructure is required to speed up the discovery of molecular mechanisms of diseases and health - this is an important step for the future of molecular medicine and the advancement of diagnosis and therapy. Academia and industry will have to work together to develop new instruments and technologies for in vivo imaging using non-invasive methods. Europe will play a global leading role in this area and will contribute an important part to the global effort to ensure the appropriate advancement in science and the future of molecular medicine.
5. Strategic importance to ERA
The infrastructure will give Europe a leading position in a worldwide competition on resources and knowledge for medically relevant mouse models. Europe will need such an infrastructure to make efficient use of the emerging wealth of mouse mutant resources.
6. Maturity of proposal (including possible timetable)
A pilot study on comprehensive phenotyping of the mouse is currently underway and concepts are under development for the proper implementation of a phenotyping infrastructure.
7. Budgetary information (preparation, construction and operation costs)
Eight centres are required to build the infrastructure for functional analysis of the mouse genome. Each centre will need for construction and first equipment €10 million (total €80 million). Upgrades and networking will require a total of €16 million per year (€2 million per centre).

1. *Project:* **Model testing facilities for biomedical research**
2. Short description of project and main characteristics
The fields of functional genomics, medically-related life sciences and systems biology strongly benefit from the usage of the mouse as a model system. In the coming decade, saturation mutagenesis in the mouse, e.g. including knockouts and conditional mutants in every gene, will be one of the major tasks of the biomedical scientific community. This will require a reorganisation of the mechanisms for mutant strain storage and distribution. The current system of interlinked mouse facilities will require reinforcement and enlargement with respect to technologies, services and partners. Especially after new member states entered the European Union, new structures have to be brought into place. In addition, the proposed infrastructure will be embedded in and play a leading role within a global effort for archiving and dissemination of mouse strains.
3. Science case (scientific justification, including new areas to be opened)
Mouse models are essential in the life sciences, for understanding mammalian biology and especially as models for human diseases. The models are required to decipher molecular mechanisms underlying disease and health. It can be envisioned that within the next decade over 25000 new mouse models will be generated in Europe. This large number is necessary to get access to functional and molecular information on an appropriate set of genes and genetic elements. To make full use of this resource it will be necessary to organise the archiving and distribution on a well-concerted, “industrial style” level. Instruments will have to be implemented which are not available currently. New freezing methods are being tested to optimize and speed up the process. The community will have to be trained to work with such material. The proposed infrastructure aims to play a leading role on the worldwide level. Mouse centres where research and infrastructure coexist, and that are leaders with respect to excellence and national importance, will be selected to become part of this infrastructure. An accessory single node of rat mutant strains (which are valuable for reasons of physiological similarity with humans) can be envisaged.
4. Impact to society and to new technologies for industry
The infrastructure is required to accelerate the discovery of molecular mechanisms of diseases and health; this is a central aspect of progress towards molecular medicine. Academia and industry will have to collaborate to meet the needs of archiving and distributing the valuable models. It does not make sense to invest in production and characterisation of disease models if their dissemination has not been organized professionally. The proposed infrastructure will be responsible for this task within Europe. It will take a global lead and will play an important part in promoting molecular medicine. Important medically relevant patents can be expected within Europe, reinforcing the strength of the European pharmaceutical industry and promoting the growth of the biotech industry in Europe.
5. Strategic importance to ERA
The infrastructure would give Europe a leading position in a worldwide competition on resources and knowledge for medically relevant mouse models.
6. Maturity of proposal (including possible timetable)
Concepts are currently under development in several European countries and global meetings of leading scientists of mouse mutant archives.
7. Budgetary information (preparation, construction and operation costs)
For initial construction and equipment €80 million are needed, upgrades and networking costs will require €8 million per subsequent year.

1. *Project:* EROHS
European Resource Observatory for the Humanities and Social Sciences
2. Short description of project and main characteristics
The purpose of EROHS is to create a coherent, comprehensive and integrated observatory that is unrivalled in the world – 'the dream machine' of the humanities and social sciences – with a view to guarantee the existence, accessibility and comparability of data at a European level. This should be organized as a physical centre, the hub, with sufficient leverage in scientific, administrative, technical and economic terms to set priorities, ensure the scientific quality of the schemes and have the authority to back its decisions. The hub will have the competence to appoint a number of related nodes on the basis of excellence and through a process of open competition. Through the nodes, a collection of sub-observatories will thus be distributed across Europe, building on existing units of expertise. These may be discipline, subject or theme-specific.
3. Science case (scientific justification, including new areas to be opened)
EROHS promises to strengthen interdisciplinary and cross-border collaboration and comparative research on a European dimension. Further, it will enhance the building of Research Infrastructure capacities in the less-resourced European countries of today. Finally, it will increase the opportunity to improve knowledge on social processes and thus holds great potential in terms of advising European and national policy-makers on how to manage the challenges currently faced by the societies of Europe.
4. Impact to society and to new technologies for industry
EROHS will facilitate new knowledge in the following ways: § The environment of improved and new data will also facilitate the generation of new research agendas and questions that cannot be addressed today. § The existence, accessibility and comparability of European data will be the defining element of the Europeanization and internationalisation of the humanities and social sciences and the structuring of the disciplines at the European level. § The existence, accessibility and comparability of European data for the social sciences and the humanities increases the opportunity to improve knowledge on social processes.
5. Strategic importance to ERA
Europe has the potential to become a natural laboratory for the social sciences and the humanities with the provision of data with an optimal combination of diversity and homogeneity – and certainly much more than is the case within each nation-state. Europe could constitute a world-leading 'best case' for research in the humanities and social sciences. Equally, both disciplines can further thrive on the massive wealth of data on demographic, societal, constitutional, institutional, political, legal, economical, cultural, linguistic, religious, and historical variations in Europe.
6. Maturity of proposal
EROHS exists as a draft proposal from the ESFRI working group on Research Infrastructures in the Humanities and the Social Sciences.
7. Budgetary information (design, preparation, construction and operation costs)
Construction costs are estimated to €27.5 million over two years. The budget is calculated on the other hand by extrapolating from similar national efforts in the humanities and social sciences on the one hand and, by taking into consideration the costing of the Council for European Social Science Data Archives (CESSDA), European Social Survey (ESS) and the Global Diversity Information Facility (GBIF).

1. *Project:* The European Social Survey (ESS)
2. Short description of project and main characteristics
Already a considerable European investment, the ESS is a multi-nation project funded jointly by the Commission, the European Science Foundation and academic funding agencies in 24 nations. Initiated by the European Science Foundation, the EC is now its biggest single funder. As the project completes its second round, central funding for a third round is already secured. The ESS has three primary objectives: (1) to monitor and interpret changing social values in Europe in relation to changing behaviour patterns and institutional structures; (2) to improve the rigour of quantitative social measurement for comparative studies throughout and beyond Europe; and (3) to develop standard social indicators to stand alongside economic indicators as measures of the quality of life in different countries and regions. To achieve these aims a meticulously-designed biennial social survey takes place among equivalent probability samples in all participating nations. The project is designed and co-ordinated by a multi-nation team headed by Professor Roger Jowell at City University London, and steered by a Scientific Advisory Board headed by Professor Max Kaase at International University Bremen. Although explicitly set up as a Europe-wide infrastructure, the ESS is still funded from round to round – an unstable basis for a time series with over 4000 registered data users in its first year.
3. Science case (scientific justification, including new areas to be opened)
In line with its three main objectives, the ESS contributes substantively, methodologically and functionally both to European governance and to scientific development. Its primary substantive aim is to understand the structure of changing attitudes, values and behaviour within and between European nations. Its main methodological aim is to keep Europe at the leading edge of the quest for equivalence in quantitative cross-national social comparisons. And its primary functional aim is to enable Europe to understand itself better via robust comparative indicators of improvements or otherwise in the quality of life both within and across countries.
4. Impact to society and to new technologies for industry
With 21 of the 25 EU member states and a number of applicant countries already involved in the ESS, the project's design, organisation and methods are already having an impact on governmental, academic and commercial institutions. Europe's thriving market research industry, for instance, has long been grappling with the difficulties of measuring the potential of a widening European market. Now the unique rigour of the ESS – long thought to be unattainable in cross-national social surveys of this type – is widely acknowledged to be the new gold standard.
5. Strategic importance to ERA
The ESS is an operational manifestation of the ERA, not simply a hitherto untested idea. Conceived in response to a widespread academic imperative, this highly ambitious project has since been taken up and sustained by the Commission in productive partnership with Europe-wide academic funding sources. Its data and methods are transparent and accessible and are in remarkably high demand, contributing both to better science and more informed governance.
6. Maturity of proposal (including possible timetable)
The ESS is a thriving concern, about to enter its third round. But, although already widely regarded as an infrastructure in its own right, it is in fact no more than a set of separately funded biennial projects. Stable long-term funding is required to ensure optimal utilisation of the ESS.
7. Budgetary information (preparation, construction and operation costs)
The ESS currently costs between €8 and €10 million per round, shared between around 27 funding agencies in 24 countries. Two new grants are being sought within FP6, one for a further round of the project and the other for infrastructure development, access and networking.

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The development of world-class Research Infrastructures is necessary to maintain Europe's position at the cutting edge of fundamental and applied research. The European Strategy Forum on Research Infrastructures (ESFRI) has compiled a "List of Opportunities" for new Research Infrastructures of pan-European interest, presented in this document. This list is a "balanced" set of 23 concrete and mature projects for large-scale Research Infrastructures which could be developed in Europe in the coming years. It will assist the European Commission in the preparation of the Seventh Framework Programme (2007-2013).

The "List of Opportunities" is the result of an intensive three-step process involving a broad consultation of the main stakeholders via the ESFRI national delegations, an analysis of proposals by the ESFRI Steering Groups and a final discussion in a plenary ESFRI meeting.

The European Strategy Forum on Research Infrastructures was launched in April 2002 to support a coherent approach to policy-making on Research infrastructures in Europe (http://www.cordis.lu/esfri/).

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