

WORK PROGRAMME
Division for Science

***eScience* -**
Infrastructure, Theory and Application (eVITA)

The Research Council of Norway
September 2005

Preface

This draft of the work programme for *eScience* in Norway was drawn up during the period May-September 2005. A first draft was circulated for review to relevant institutions on 15 August 2005, with a deadline of 9 September for submission of comments. The final draft was completed on 21 September after submitted input had been incorporated and a consultation meeting had been held at Gardermoen on 31 August.

This work programme draws on a number of documents in addition to those directly cited in the text. The most important of these are two Norwegian national reports, *eVitenskap og Anvendelser – Forskning i en ny epoke (eVITA)* (eScience and Applications – A New Epoch in Research) and *Matematikk for anvendelser* (Mathematics for Applications), which were provided as input to Report No. 20 (2004/2005) to the Storting, *Commitment to Research*. Other important sources of information include various reports from the EU, including the *e-Infrastructures Roadmap* (<http://www.e-irg.org/roadmap/>), and from the USA we have taken inspiration from the document, *Computational Science: Ensuring America's Competitiveness* (<http://www.nitrd.gov/pubs/>).

In this work programme we are using the term *eScience* (Norwegian: *eVitenskap*), which has come into fairly widespread use in Europe (the EU system). *eScience* is essentially synonymous to the term *computational science* as now used in the USA (see the definition in the document cited above). But *eScience* has a wider reach than *computational science* (which includes computational methodology research), with the added content consisting chiefly of investment in and effective application of infrastructure for computing and data storage.

In its mandate for the planning group's activity, the Research Council of Norway asked that the programme be organised in such a way as to ensure an optimal interface between research and infrastructure, particularly as it relates to long-term planning of investments in infrastructure.

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eScience – Infrastructure, Theory and Application (eVITA)

Summary

“The most scientifically important and economically promising research frontiers in the 21st century will be conquered by those most skilled with advanced computing technologies and computational science applications.”¹

eVITA is a research and infrastructure programme designed to address computing- and data-intensive challenges in science, technology and medicine. By promoting research on methodologies, competence development and investment in new *eInfrastructure*, eVITA will work to ensure that Norwegian research in the *eSciences* achieves a high international standing, and seek to address important national challenges in the national priority areas of energy and the environment, oceans, food, and health. This will give a solid boost to the natural sciences in direct response to the main structural and thematic priorities described in *Commitment to Research*². Mathematics, informatics and statistics, – all disciplines that focus on methodologies – together with a selection of scientific and industrial applications, comprise the main body of the programme’s research component. The infrastructure component will ensure adequate and reliable access to computing power and resources for handling large volumes of data for Norwegian researchers and for operational weather forecasting. The eVITA research programme will also provide Norway with an effective tool for mounting a concerted research effort in the *eSciences* and investment effort in relevant *eInfrastructure*.

The eVITA programme is also designed to reinforce important aspects of other major national initiatives being carried out by the Research Council of Norway. This applies particularly to the large-scale programmes NORKLIMA (Climate changes and consequences for Norway), FUGE (National programme for research in functional genomics in Norway), PETROMAKS (Programme for the optimal management of petroleum resources) and NANOMAT (Nanotechnology and new materials, but will over time come to include such programmes as HAVBRUK (AQUACULTURE – an industry in growth) and RENERGI (Clean energy for the future) as well. In line with the thematic priorities defined in the Government’s *Commitment to Research* report, eVITA will give priority to challenges relating to high-volume computing and data in the petroleum industry, the development of new sources of energy, transportation, problems in weather and climate, marine resource management, maritime challenges, the spread of pollution, studies of biological and biochemical processes, medical causal research as well as high-volume data storage, modelling and analysis (biobanks).

¹ From the executive summary (page 1) in *Computational Science: Ensuring America’s Competitiveness*, by the President’s Information Technology Advisory Committee, USA, 2005.

² Report No. 20 (2004-2005) to the Storting, *Commitment to Research*, see <http://odin.dep.no/ufd/norsk/dok/regpubl/stmeld/045001-040014/dok-bn.html>

The objectives and measures described in this programme require a budget framework of NOK 110 million per year starting in 2008, of which NOK 50 million is reserved for investment in *eInfrastructure*. However, the planning group recommends increasing the budget framework to NOK 170 million per year, of which NOK 70 million is reserved for investment in *eInfrastructure*. The planned programme period is ten years (2006-2015).

1. Background

More data will be compiled and produced in the next five years than has been created throughout the entire course of human history³, carrying with it major new challenges. At the same time, advances in computer performance, storage capacity and high-speed communications networks will enable the development of new and sophisticated analytical methods and the achievement of unforeseen scientific discoveries. Progress in science, and, gradually, the development of society at large, will depend increasingly on the availability of high-performance computing power, appropriate technology for storing and managing large volumes of data, as well as secure and dependable high-speed digital communication. New methods and systems for effective utilisation of the available computing and data storage capacity must be developed, as well as tools and computational methods for managing the quantities of data that are compiled and produced. Mathematics, statistics and informatics have a particularly important role to play in utilising the scientific and industrial potential inherent in the quantities of data involved. While most of the applications that depend on high-performance computing and high-volume data management are to be found in science, technology and medicine, the scope of comparable problems is expected to grow in the fields of economics and finance, as well as in some of the social sciences and humanities.

eScience consists of a range of rapidly growing disciplines whose main objectives are to understand and resolve complex, actual problems and phenomena. *eScience* is a synergy of the following three main elements:

- The development of new theories, models, methods, algorithms and software addressing important computing- and data-intensive challenges faced by science and industry.
- The establishment and development of a smoothly-functioning *eInfrastructure*, including computing resources, high-volume data storage resources, high-speed digital communication resources, and the software systems needed to give users access to these resources.
- Information and communication technology for optimum and secure utilisation of available computing resources and for managing large volumes of data.

Research in the *eSciences* is already essential for solving complex problems in many sectors of society. Progress in the fields of mathematics, statistics and informatics will make it possible to develop tools for processing and utilising large quantities of data from experiments and observations, as well as to address problems whose solutions

³ <http://www.sims.berkeley.edu/research/projects/how-much-info-2003/> and <http://www.lesk.com/mlesk/ksg97/ksg.html>

have previously been considered beyond the realm of practical possibility. Moreover, research in the *eSciences* provides an increasingly important supplement to theoretical studies and physical experiments in the form of simulations. Simulations require substantial amounts of computing power, and often present the only alternative where physical experiments are ruled out because they are controversial (biology, medicine), dangerous (fire), illegal (radioactivity), impossible (climate), or expensive (flow in oil reservoirs).

eVITA consists of two components: a research component and a component for investment in *eInfrastructure*. The research component will focus on general research in the fields of mathematics, statistics and informatics, research that addresses specific scientific and industrial applications in science, technology and medicine, as well as research targeting cost-effective utilisation of the national *eInfrastructure*. Within these bounds, *eVITA* will seek to facilitate the advance of new working methods and forms of cooperation and to dismantle traditional dividing lines between disciplines. *eVITA* will also promote active participation in Nordic and European *eScience* initiatives, thereby supporting the government's focus on the internationalisation of research as expressed in *Commitment to Research*. *eVITA*'s infrastructure component will ensure that adequate and reliable computing power is made available to Norwegian research communities and for operational weather forecasting. By focusing on mathematics, statistics and informatics and their application to problems in science, technology and medicine, *eVITA* will directly support the national priority on research in the natural sciences set out in *Commitment to Research* while at the same time promoting a much-needed modernisation of these fields.

Evaluations⁴ carried out by the Research Council in recent years show that Norway has a number of top international-level research groups working in the *eSciences*. These include researchers in mathematics, statistics and informatics, as well as groups developing methods for solving problems in science, technology and medicine. Norway is thus in a good position to launch a large-scale programme in the *eSciences*. Moreover, a well-developed *eInfrastructure* and dynamic research communities in the *eSciences* are essential prerequisites for scientific progress in a wide range of research fields in medicine and the natural sciences. Significant investment in *eInfrastructure* and *eScience* would also widen the opportunities and enhance the synergies between key national initiatives such as NORKLIMA, PETROMAKS, NANOMAT, FUGE within the Research Council.

2. Objectives (and secondary objectives)

The objectives described below are based on a 10-year time frame (2006-2015) and a moderate budget framework. The budget is described in Section 10. The ramifications of low budgets and the possibilities available within the recommended budget frameworks are discussed in Section 11.

2.1. Primary objectives

⁴ The Research Council of Norway has conducted a number of evaluations over the past ten years in the fields of mathematics, statistics and informatics, as well as in all science and technology disciplines in Norway. See www.forskningsradet.no.

By promoting research on methodologies, competence development and investment in new *eInfrastructure*, *eVITA* will work to ensure that Norwegian research in the *eSciences* achieves a high international standing, and seek to address important national challenges in the thematic priority areas of energy and the environment, oceans, food, and health as described in the government report *Commitment to Research*.

2.2 Objectives for the research component

The following objectives are defined for *eVITA* for the programme period (2006-2015):

- To boost Norwegian research in the *eSciences* to a high international level and make Norwegian research communities attractive partners in international research projects. This includes obtaining more support from EU framework programmes and strengthening the position of Norwegian research communities in transatlantic collaboration.
- To achieve international breakthroughs in the *eSciences* in three areas important to Norway, to encourage regular publication in high-ranking scientific journals, and to organise at least two major international conferences in Norway in the course of the programme period.
- To develop at least three strong interdisciplinary research communities at the interface between mathematics/statistics/informatics and other disciplines in science, technology and medicine.
- To ensure active participation in EU framework programmes in the *eSciences*, including responsibility for coordinating at least three large-scale international projects and/or programmes in the *eSciences*.
- To establish a common national forum for the *eSciences* similar to the Winter Schools in Computational Mathematics⁵.
- To develop the necessary foundation for meeting the structural and thematic priorities established in the government report *Commitment to Research*, by focusing on basic research in mathematics, statistics and informatics.
- To achieve a significant increase in the number of women involved in *eScience* research.
- To employ targeted information activities to generate a greater interest in the natural sciences and technology in the Norwegian public at large and in schoolchildren in particular.

2.3 Objectives for the infrastructure component

The following objectives are defined for *eVITA* for the programme period (2006-2015):

⁵ The Winter Schools in Computational Mathematics are one example of an arena in which students and scientists from Norway and other countries can meet every year. This is a project that examines topics in the fields of computational science and computational mathematics and informatics. Responsibility for the academic content is shared by the various research communities in Norway. The Winter Schools have achieved considerable popularity, not least among young scientists who through this project have established lifelong relationships/lasting networks with other scientists. The Winter Schools are funded by the Research Council of Norway through the BeMatA (Computational mathematics in applications) programme.

- To be a driving force behind the financing and development of national *eInfrastructure* as part of the global *eInfrastructure*, with a special emphasis on further developing Nordic cooperation. With respect to *eInfrastructure*, funding has been allocated to this programme for investing in computing resources, high-volume data storage resources, and the software systems necessary to give users access to these resources. Investment in high-speed digital communication is an essential aspect of *eScience*, but this is being financed through other channels⁶.
- To ensure that investments in *eInfrastructure* will at all times meet:
 - The needs of Norwegian researchers for computing power, storage capacity and management of extremely large volumes of data.
 - The needs of the Norwegian Meteorological Institute related to operational weather forecasting.
- To develop the operating environments Norwegian *eInfrastructure* will need in order to ensure the ability to continually offer high-end user support of top international standards.

3. Important R&D tasks

The *eScience methodology disciplines* comprise mathematics, statistics and informatics. These disciplines, together with selected scientific and industrial applications, comprise the main focus of *eVITA*'s research component. *eVITA* will provide funding to research projects aiming to develop new theories, new models, methods, algorithms, techniques and tools for applying high-volume computing and data resources to problems in science, technology and medicine.

Projects dealing mainly with generic problems in the *eScience methodology disciplines* or focusing on specific methodology problems in a given area of application will be weighed up against a smaller number of larger-scale projects focusing on scientific and/or industrial applications. With respect to the large-scale projects, priority will be given to areas of special significance for Norway, and documentation must be provided that the application of *eScience* offers particular potential for progress in the field. Relevant applications will be found in the petroleum sector, in transport, process industry, the marine and maritime sectors, climate and weather studies, medicine, nanotechnology and biotechnology (see also the discussion of thematic priorities in *Commitment to Research*). Methodological problems linked to applications of this type occur in most technical and scientific disciplines.

The *eVITA* programme will promote investment in *eInfrastructure* as a means of ensuring the availability of adequate and reliable computing power for Norwegian research and operational weather forecasting. *eVITA*'s research component will also provide funding for projects aiming to improve the effective utilisation of the investments in *eInfrastructure*, including the development of GRID technology. This will facilitate collaboration among scientists and between research communities and industry/government administration. GRID is an emerging technology that provides flexible, reliable and coordinated sharing of distributed electronic resources among

⁶ Uninett AS, a government corporation under the Ministry of Education and Research, is responsible for developing and operating high-speed digital communications in the research sector.

researchers and research groups. Efforts are under way at the national, European and international levels to realise the scientific potential of applying of GRID technology to integrate high-speed digital communications, high-performance computing facilities, high-volume storage systems, data-acquisition systems and research databases. It is imperative that Norway takes part in these developments today if our research communities and, in the long run, our industrial sector and community at large are to enjoy the benefits of tomorrow's global *eInfrastructure*.

3.1 The research challenges

All research projects funded by this programme shall exhibit clear potential for solving computing- and data-intensive challenges in science, technology and medicine. On this basic premise, the programme will provide funding for:

- Research targeting specific scientific and industrial applications that call for interdisciplinary skills and collaboration between the *eScience methodology disciplines* and disciplines in science, technology and medicine.
- Generic research in the *eScience methodology disciplines* – mathematics, statistics and informatics – i.e. the development of new theories, new methods, models, algorithms, techniques and tools with a wide range of applications.
- Research aiming for optimum cost-effective utilisation of new *eInfrastructure* with a special focus on the quality and security of the services offered and the problems associated with the creation and utilisation of large volumes of data.

3.2 Thematic priorities in the research component

The *eScience methodology disciplines* are to comprise a substantial component in all projects receiving funding from this programme. However, no more than 60% of the programme's financial resources will be allocated to large-scale interdisciplinary research projects. The four thematic areas outlined in the government report *Commitment to Research* – energy and the environment, oceans, food, and health – will be given priority.

- Under *energy and the environment*, preference will be given to projects focusing on the petroleum industry and the development of new sources of energy, on transport, and on problems relating to weather and climate.
- Under *oceans and food*, preference will be given to projects focusing on marine resource management, maritime challenges and the spread of pollution.
- Under *health*, preference will be given to projects focusing on studies of biological and biochemical processes, medical causal research, as well as high-volume data storage, modelling and analysis (biobanks).

A proportion of the programme's resources will be allocated to medium-scale projects focusing on generic problems in the *eScience methodology disciplines* and on specific methodology problems in selected areas of application. For obvious reasons, these projects will have a more open profile, though grant proposals must also in these cases provide an account of the areas of application which will be given priority. A typical project in the *eScience methodology disciplines* will normally focus on the development of new theories, new models, methods, algorithms, techniques and tools that can be applied to a wide range of computing- and data-intensive applications. The medium-scale projects and the size of them are described in the following section.

Research projects focusing on the development and effective application of new *eInfrastructure* will be viewed wholly in connection with the programme's need to develop better infrastructure for distributed high-performance computing and high-volume data management. These projects must be linked to one or more specific applications.

The interplay between *eVITA* and other programmes under the Research Council of Norway is important, and is discussed in Section 4.

3.3 Three types of research projects

The *eVITA* program will provide funding for three types of research projects:

- Large-scale interdisciplinary projects in the *eSciences* that focus on the programme's thematic priorities. Each project will have an annual budget of NOK 4-6 million. This type of project will represent no more than 60% of the programme's research component.
- Medium-scale projects focusing on the *eScience methodology disciplines* and on the development of new solutions for optimum utilisation of *eInfrastructure*. These projects will have annual budgets of NOK 1-2 million. This type of project will represent at least 40% of the programme's research component.
- A small number of small-scale projects targeting special information activities and selected measures for promoting international collaboration.

Allocation of funds in the first two categories will be based on international quality assessments in keeping with the at all times current practices of the Research Council of Norway. All projects in the first two categories will have duration of up to five years. Grant proposals in the third category will be dealt with by the programme board, and will have duration of up to two years. Further details regarding the application process will be provided in the Research Council call for proposals.

At least 60% of the programme's overall research funding is to go towards researcher recruitment (see also Section 6). All grant proposals must specify measures to promote increased participation of women in *eScience* research. Proposals must also specify planned information activities, including measures to promote research-based innovation (see also Section 8).

4. The relevance of the programme to the Research Council's strategy

The *eVITA* programme comprises a major initiative for updating and modernising much of the natural science sector, and thus responds directly to the target stated in *Commitment to Research* to step up efforts in the natural sciences and technology. In addition to the specific priorities defined in the government report and presented in the previous section, it is worth noting that other aspects of the thematic areas outlined in the report involve challenges of both direct and indirect relevance to the *eScience* initiative. Nanotechnology and biotechnology are also areas in which the problems addressed by *eScience* are becoming increasingly relevant. Moreover, the *eScience* effort is a direct response to the Division for Science's action plan for basic research,

which calls for a greater focus on basic research in the natural sciences and technology.

The planning process for the *eVITA* programme included an assessment of the content of the Research Council's major initiatives, starting with the large-scale research programmes established recently. The *eSciences* comprise an integral part of the activities of the FUGE, NORKLIMA, NANOMAT and PETROMAKS programmes. At present, HAVBRUK and RENERGI occupy a more peripheral position in this regard, though activities in these programmes, too, will ultimately benefit from *eScience* expertise. The *eVITA* programme will not, however, commonly accept applications with methodology components falling within the purview of the major programmes. These programmes must still maintain room within their thematic areas for projects that address computational challenges and high-volume data management challenges. In relation to these programmes, *eVITA*'s research component will focus on extraordinary bottlenecks (in size and in relevance) as well as on broadly applicable computing- and data-intensive problems.

Research activities funded by *eVITA* that involve pure information and communications technology (ICT) must focus on computing and data-intensive applications, and as such be complementary to the research taking place within the VERDIKT (ICT Core Competence and Growth) programme. In addition to establishing important principles for the development of global *eInfrastructure*, research in the *eSciences* may also generate cost-effective solutions for the same infrastructure. The *eSciences* are thus an essential component of today's communications technology, not least because large databanks are increasingly being viewed as an integral part of infrastructure solutions in the private and public sectors. It is also important in this context to highlight the significant impact that the *eSciences* are expected to have on the transport of goods, services and people. Development of digital infrastructure, including more advanced methods of storing and processing information, expands the potential for achieving more cost-effective and environmentally-friendly transport in terms of physical infrastructure such as roads, railways, seaports, sea lanes and so forth. Given Norway's geography and demographic profile, together with the substantial distances to the major markets, this is an issue of extreme importance to Norway.

Depending on the scope and portfolio of the programme's projects, it will be appropriate to define various points of collaboration between *eVITA* and other Research Council programmes.

eVITA will also need to accommodate important initiatives in Scandinavia, Europe and North America. Examples include the development by the EU of an *eInfrastructure* "road map", EU and Nordic GRID initiatives (NORDUGRID, Nordic Data Grid Facility), as well as the EU's commitment to *eScience* in existing and future framework programmes. The EU's *eScience* effort is extensive and it is growing; it is important for *eVITA* that Norwegian participation in EU framework programmes is expanded.

5. Target groups – programme participants

eVITA's target groups are researchers and research groups at universities, university colleges and research institutes. Applicants are encouraged to seek collaboration with industry and other private enterprise as well as with the public sector. With regard to the infrastructure component, all researchers, including those not working within the research component, may seek access to the national *eInfrastructure* pursuant to the current valid guidelines utilised by the Research Council of Norway.

6. Competence-building

As a number of evaluations of Norwegian research in mathematics, science, technology and medicine have pointed out in recent years, a new generation of Norwegian researchers is emerging. Skills in the interface between different disciplines are becoming increasingly important, and thus this programme will keep a focus on interdisciplinary research and competence-building. In addition to cutting-edge skills in a specific discipline, it is important that researchers in the *eSciences* possess the skills needed in relation to other relevant disciplines. *eVITA* funding criteria highlight the importance of recruiting new researchers in the cross-roads between the *eScience methodology disciplines* mathematics, statistics and informatics on the one hand, and selected disciplines in science, technology and medicine on the other. At least 60% of the programme's research funding is to go towards researcher recruitment positions. The proportion of women researchers in the *eSciences* is extremely low, so one of the priorities of this programme is to achieve a noticeable increase in this number. Given that such a large percentage of programme resources will be devoted to researcher recruitment, a significant proportion of the researchers recruited must be women. All applicants must therefore provide information on planned measures to meet this objective.

The Research Council does not provide funding for free-standing doctoral fellowships in Norway⁷, which means that any doctoral fellowships must be linked to specific projects. However, the programme can provide funding for personal doctoral fellowships abroad and personal post-doctoral fellowships. The programme will also give priority to projects involving research exchanges with foreign institutions, especially from countries in the EU or North America. A national researcher forum for the *eSciences*, with researchers from abroad invited to take part, is among a number of special competence-building measures proposed.

7. Infrastructure

Infrastructure for high-performance computing and high-volume data storage, referred to here as *eInfrastructure*, is of considerable importance to many groups of researchers in Norway. New users and new areas are appearing on an ongoing basis. The productivity of the researchers and the quality of the findings generated are directly linked to the availability of *eInfrastructure* of high international calibre. Emerging research challenges call for increased integration of computing resources, high-volume data storage resources and data-acquisition hardware, all interconnected

⁷ The Research Council of Norway provides personal doctoral and post-doctoral research fellowships for overseas research.

in a secure and reliable high-speed communication network. The major communities traditionally involved in scientific computing and high-volume data management are found in the natural sciences, and the continual development of up-to-date *eInfrastructure* is absolutely essential to fulfil governmental objectives to strengthen basic research, particularly in the natural sciences, as stated in the *Commitment to Research* report.

In recent years, allocations to *eInfrastructure* channelled through the Research Council of Norway have remained steady at NOK 22 million per year. The Research Council has contracted with Uninett Sigma AS, a subsidiary of Uninett AS, to administer and apply these allocations through the NOTUR II project⁸. It is crucial that this allocation be increased to at least NOK 50 million in order to ensure that Norwegian research communities have access to the high-volume computing and data resources they need in order to work at the forefront of the international research effort (see Section 11). An increase of this size would also make it possible to offer high-end support to new user groups in such disciplines as biology, medicine, the social sciences, finance and economics.

The *eVITA* programme will have the overall strategic responsibility for developing Norway's *eInfrastructure* and will thus lay the foundation for Uninett Sigma AS for its planning and operative administration of the allocations channelled through the Research Council. The objectives of the programme's infrastructure component are defined in Section 2, and its organisation under the Research Council is discussed in Section 9.

8. Information and dissemination

eVITA's primary dissemination objective is to make Norwegian research visible via publication in high-ranking international journals. Other objectives are to see major international conferences arranged in Norway and to establish a Norwegian research forum in the *eSciences* with international participation.

All research projects are to have a dissemination component extending beyond traditional publications targeted towards generating greater awareness of the natural sciences and technology in the public at large and a particular focus on popularisation measures to reach schoolchildren. Popular-science publications and information activities are to be consolidated and made available to the schools.

Research-based innovation is an important feature of research dissemination activity, and all projects must provide information about measures aimed at technology transfer to society, including measures for research-based innovation.

9. Organisation

The *eVITA* programme is responsible for ensuring that the needs of Norwegian researchers vis-à-vis the development of a national *eInfrastructure* are fulfilled. However, the need for *eInfrastructure* transcends the range of research tasks

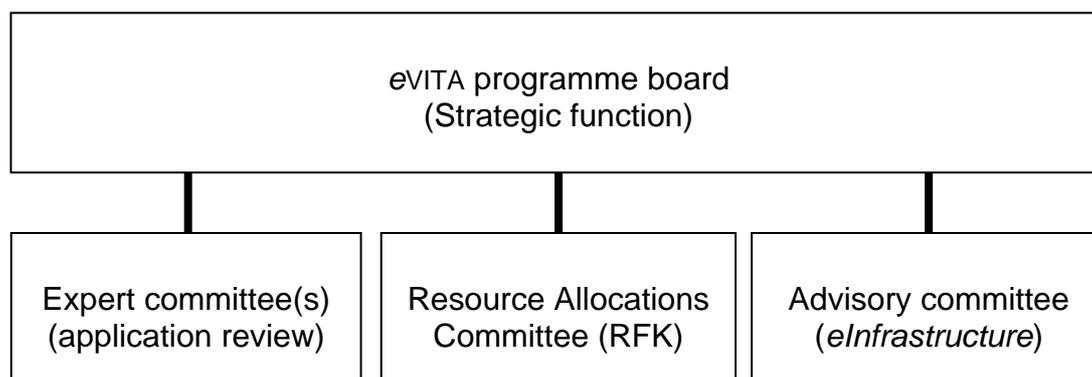
⁸ The Norwegian Metacenter for Computational Science – NOTUR II, project agreement between Uninett Sigma AS and the Research Council of Norway.

encompassed by this programme's research component. A separate advisory committee will therefore be established for investments in *eInfrastructure*. Based on a mandate formulated by the programme board, this committee will provide input to the programme board on:

- Long-term investment strategies
- International technology trends
- Needs for computing resources and data resources and high-end user support in Norwegian research and operative weather forecasting

The advisory committee will also assess the need for investments in *eInfrastructure* essential to various national initiatives, including the Research Council's large-scale programmes.

The Resource Allocations Committee (RFK)⁹, previously organised under various high-performance computing programmes but now sorting directly under the Research Council's Division for Science, will be moved to *eVITA*. The RFK will continue to have operative responsibility for allocating resources among the various users of the national *eInfrastructure* that is in operation at any given time.



eVITA organisation

The programme board, on behalf of the Research Council, will formulate long-term strategies for *eInfrastructure* investments in Norway based on input from the advisory committee and Uninett Sigma AS. Uninett Sigma AS will have operative responsibility for the cost-effective management of the allocations made available for investment in *eInfrastructure*. The first investment period is 2006-2010. The programme's infrastructure component, including the NOTUR II project, will be evaluated well in advance of the second investment period, which is 2011-2015. *eVITA*'s programme board must establish appropriate mechanisms for ongoing follow-up of NOTUR II.

eVITA's programme board has wide-ranging strategic responsibilities, and it is necessary to distinguish between strategic tasks and the allocation function for the programme's research component. A distinction of this nature was also recommended

⁹ The Resource Allocations Committee (RFK), on the basis of applications, allocates computing time on the national computing resources among the various research communities. The RFK is appointed by *eVITA*'s programme board.

by a committee¹⁰ that assessed impartiality in the Research Council. To separate the strategic from the allocation functions, an expert committee will be created for application assessment. Several expert committees may be created, depending on the size of the programme. All grant proposals, except for a small number of applications for funding for special dissemination measures and international collaboration (see Section 3.3), will be reviewed by a committee of international referees on the basis of the applicable rules and procedures in the Research Council.

10. Distribution of funds

The table below shows how the programme's financial resources will be distributed between research projects in the *eSciences* and investments in *eInfrastructure*. Allocations to the two components will chiefly be determined in relation to guiding principles issued by the Research Council and relevant funding ministries. Earmarking of a minor proportion of the funding may be anticipated for meeting international obligations, including Nordic cooperation in the development and application of GRID technology. Investments in GRID technology are encompassed by the programme's infrastructure component, while research activities in this area are part of the research component (see also Section 3).

Priorities and objectives outlined in this work programme are based on a moderate budget framework. The ramification of a low budget and the potential implicit in the recommended budget are described in Section 11.

	2006	2007	2008	2009	2010-15	Sum
Low budget						
Research	16	30	30	30	240	346
Infrastructure	22	22	22	22	132	220
Total low	38	52	52	52	372	566
Moderate budget						
Research	30	40	60	60	360	550
Infrastructure	35	50	50	50	210	395
Total moderate	65	90	110	110	570	945
Recommended budget						
Research	50	80	100	100	600	930
Infrastructure	50	70	70	70	360	620
Total recommended	100	150	170	170	960	1550

Low, moderate and recommended budget frameworks (all figures in million NOK).

¹⁰ *Forskningsrådets legitimitet, habilitet og kvalitet i søknadsbehandlingen*, the Research Council of Norway, February 2004.

11. Low and recommended budget frameworks

The Research Council of Norway has asked the planning group to define objectives and measures in this plan on the basis of a moderate budget framework (see table in previous section).

11.1 The ramifications of a low budget

A low budget framework would represent a substantial decline in Norwegian research and would be inconsistent with the objectives defined in the government report *Commitment to Research*.

A low budget framework would give the infrastructure component NOK 22 million per year. This level of funding would mean that Norway would not be able to field sufficient resources to meet the needs of many existing user groups. This would have a negative impact in particular on NORKLIMA, one of the Research Council's large-scale programmes. Norway's model-based climate research effort would no longer be able to keep up with international developments and would no longer be on the cutting edge. Other major programmes such as FUGE, NANOMAT and PETROMAKS would be greatly impaired by a low budget framework. There is no way *eVITA* would be able to cover the investments necessary to address the thematic priorities stipulated in *Commitment to Research*. One essential task implied by a low budget framework is to establish a set of strict criteria for determining which user groups would be given priority.

A low budget framework would give the research component NOK 16 million in 2006, increasing thereafter to NOK 30 million per year. A low budget framework would result in the following priorities:

- The programme would not be able to include Nordic cooperation in *eInfrastructure* development.
- The programme would not give priority to investments in GRID technology and research projects focusing on the development of GRID technology.
- The programme would not be able to meet future needs for computing resources for operational weather forecasting, including prediction of extreme weather situations.
- The programme would have to give priority to funding in the *eScience methodology disciplines* over funding of large-scale interdisciplinary research projects focusing on specific problems and applications.
- Programme funds would have to go chiefly to recruitment positions.
- No more than *one* international breakthrough by a Norwegian research network could be expected in the *eSciences* in the course of the programme period.
- A small number of research networks in the *eSciences* would be able to achieve high international standing, and the ability of Norwegian researchers to compete for research funding in the international arena would be limited.
- To attain sufficient scope and quality, research in a few selected niches in weather and climate research, in medical science and in marine problems would have to be given priority over other areas.

11.2 The potential of the recommended budget

If we are to fulfil the primary objective defined in the government report *Commitment to Research*, "...to ensure that Norway occupies a leading position internationally in terms of new technology, skills and knowledge," then the recommended budget framework is essential.

The recommended budget would give the infrastructure component NOK 70 million per year. This level of funding would enable Norway to develop its *eInfrastructure* on a par with the other countries of Europe¹¹.

The recommended budget would give the research component NOK 50 million in 2006, increasing thereafter to NOK 100 million per year. This budget framework would provide room for the following priorities and potential in addition to those available within the moderate budget framework:

- The programme would help meet all of the most important challenges addressed in the government report *Commitment to Research* (Norway's initiative in the *eSciences* would match that of other countries in Europe) and bring Norwegian research in the *eSciences* up to a high international level.
- Through extensive, targeted dissemination activities, the programme would generate a greater awareness of and interest in the natural sciences in the Norwegian public at large and in schoolchildren in particular.
- In addition to the thematic priorities set out in Section 3, the programme would be able to incorporate all relevant applications of the *eSciences* to problems in science, technology and medicine, as well for applications of the *eSciences* to certain problems in the social sciences, the humanities, finance and economics.

Compared to a moderate budget framework, the recommended budget framework would expand the scope of the programme to include the following revised objectives:

- To achieve international breakthroughs in the *eSciences* in six areas, publication in a substantial number of high-ranking journals, and to organise at least four major international conferences in Norway in the course of the programme period.
- To develop at least six strong interdisciplinary research communities in the cross-roads between the methodology disciplines in the *eSciences* and disciplines in science, technology and medicine.
- To make Norway a leading player in the EU framework programmes in the *eSciences*, including responsibility for coordinating at least six large-scale international projects or programmes.
- To create a national meeting-place for the *eSciences* and turn it into a top-level international forum.
- To secure an active role for Norway in the joint Nordic *eInfrastructure* development effort, and to make Norwegian research communities attractive partners for Nordic, European and transatlantic collaboration.

¹¹ *Tungregning mot 2010 [Supercomputing up to 2010]*, Gropen et. al., the Research Council of Norway, Aug. 2002, and *The future of high-performance computing in Norway*, Nieminnen et. al., the Research Council of Norway, Nov. 2003.

- To meet future needs for computing resources for forecasting extreme weather conditions that may have a major economic impact on society.
- To ensure access to *eInfrastructure* at all times for all key segments of *eScience* research in Norway.