Excerpt from:

"Call for Grant Applications: Strategic Research Areas"

2009-01-19

Call for Grant Applications: Strategic Research Areas

Background

The Government bill on research and innovation proposed increased support for strategic research areas. More specifically, during 2009 to 2012 the additional resources for the 24 strategic research areas will mean an increase of 1800 million Swedish kronor (SEK) to Sweden's higher education institutions (HEIs in the following). This call for grant applications includes 20 of these areas, and the level of increase in grants for the areas during the period will reach SEK 1315 million per year see table. Normally, at least two HEIs will be chosen for targeted initiatives in the respective areas.

The Government used three criteria in prioritising the strategic areas. Strategic initiatives should address:
- research that, in the long term, has the prerequisites to be of the highest international quality,
- research that can contribute towards fulfilling major needs and solving important problems in society,
- research in areas that have a connection to the Swedish business sector.

During the spring of 2009 the Swedish Research Council (Vetenskapsrådet), the Swedish Council for Working Life and Social Research (FAS), the Swedish Research Council for Environment, Agricultural Sciences, and Spatial Planning (Formas), the Swedish Energy Agency (Energimyndigheten), and the Swedish Agency for Innovation Systems (VINNOVA) will manage the call for, and review of, grant applications from Sweden's HEIs in all of the strategic research areas announced by the Government. Decisions concerning funding of the 20 areas covered by this call for applications will be made by the Government.

The agencies can make recommendations to the Government to allocate resources for large national infrastructures within the framework of the strategic research initiatives.

Who can apply?

Applicants for these grants should be one or more collaborating Swedish HEIs. Each HEI can be the main applicant for only one grant application per strategic area. The main applicant bears the overall responsibility for the initiative's construction. The HEI may also be involved with specified parts of one or more other applications in the same area. Collaborating research institutes can be financed from the grants. Researchers may be involved in several applications.

Excerpt from the
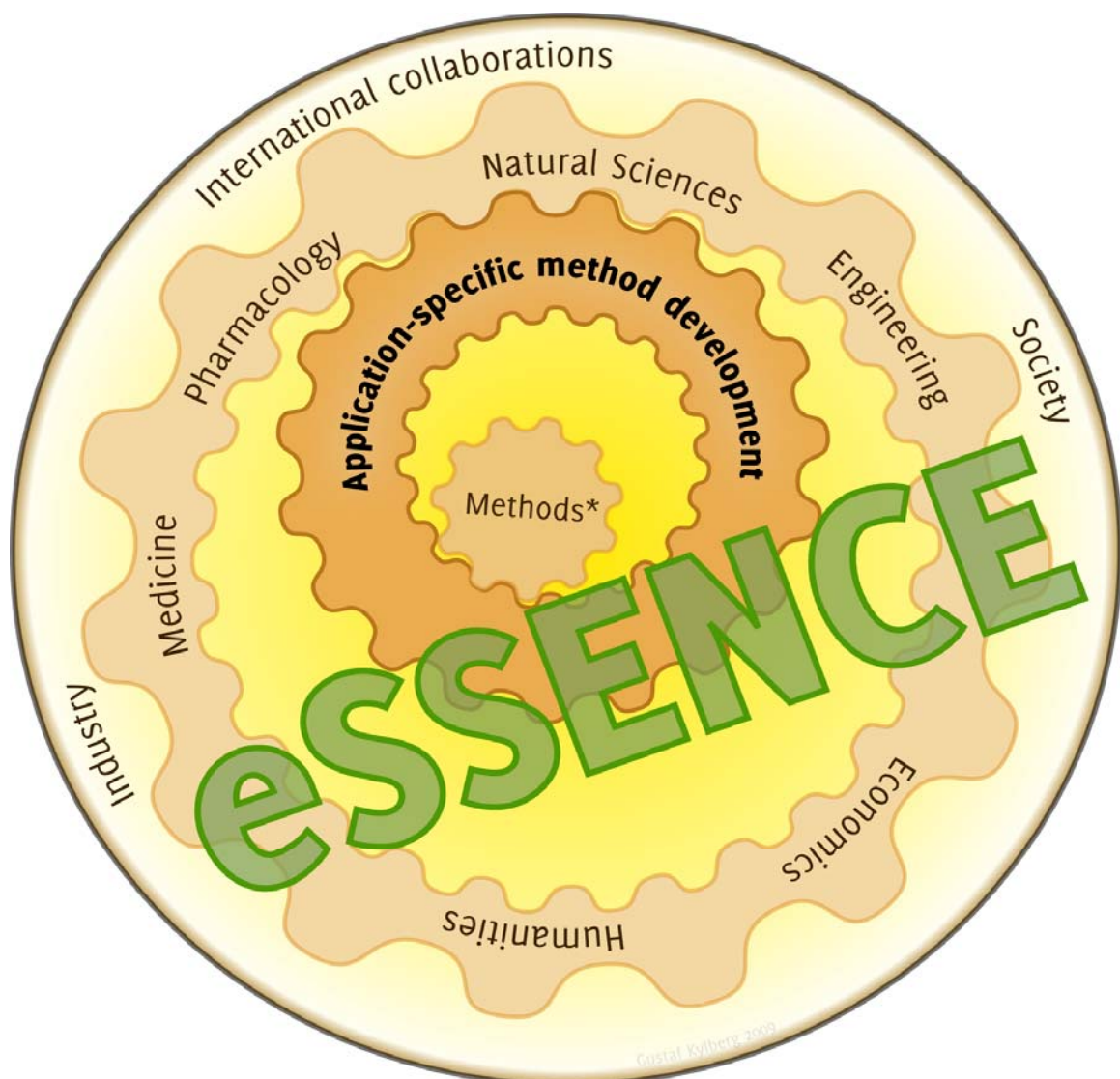
eSSENCE

application

2009

UPPSALA
UNIVERSITET

LUNDS
UNIVERSITET

UMEÅ
UNIVERSITET

eSSENCE

an eScience Collaboration

International collaborations

Natural Sciences

Pharmacology

Application-specific method development

Engineering

Society

Methods*

Medicine

eSSENCE

Industry

Economics

Humanities

Gustaf Kylberg 2009

* Methods: Mathematical/Statistical Models, Computational Algorithms, Sensor Technology, Database Technology, High-Performance Parallel Computing, Distributed IT Systems and Grid Computing, Visualization and Image Analysis

Attachment 1: Executive Summary

eScience has emerged as the third pillar underlying research, complementing theory and experiments and introducing a fundamental change in the scientific method. eScience advances the frontiers of science and technology in research areas where traditional experimental and theoretical approaches are not sufficient. In eScience, scientific breakthrough builds on powerful and accurate models, computational tools and methods that are adapted to the particular discipline as well as a powerful infrastructure of computer-based resources. Furthermore, eScience provides novel opportunities for collaboration between experts, in academia and industry, within the same and different disciplines, and over short and long geographical distances.

The constellation of Uppsala University (UU) in partnership with Lund University (LU) and Umeå University (UmU) proposes to launch **eSSENCE**, a strategic collaborative initiative in eScience for a new era of research and innovation.

The cornerstones of **the eSSENCE Platform** are excellence and renewal in **eScience applications, eScience method development, eScience education, eScience infrastructure, and strong eScience interplay with the surrounding society and industry**. Indeed, this initiative builds on established excellence in a **complete span** of eScience research areas and eScience education, application areas as well as methods and tools development. The participating universities recognize the strategic importance of eScience and strongly support the eSSENCE initiative. With its existing collaborative structures in place, and strong involvement in national and international eInfrastructures, eSSENCE is optimally positioned as a platform for increasing Sweden's international scientific competitiveness in eScience.

The academic foundation of eSSENCE in three complete university environments provides a mix of high-quality **eScience application areas** of documented strength, many in key strategic areas, such as materials science, genomics, natural resources, and economic demography, and ranging from curiosity-driven theoretical investigations to collaboration with industries and the surrounding society state-of-the-art competences of documented strength in **eScience methods and tools** complement the fundament of eSSENCE, covering scientific and parallel computing, database techniques, advanced parallel programming, development of grid technology, and visualization. Each of the partner universities offer highly developed support structures for spin-off benefits of research findings.

The Vision of eSSENCE is to create an eScience environment where an increased awareness among the different eScience actors − in applications, algorithms, tools, infrastructure development and education − will lead to a much more efficient interplay between the competences and open up the field for novel applications, more realistic simulations, new scientific solutions and unprecedented excellence in Swedish eScience.

The goal of eSSENCE is therefore to to affect all stages of the eScience process. As the key strategy for achieving this goal, new modes of communication will be invoked, education will be renewed, new opportunities for young researchers will be prioritized, the dissemination and the strengthening of eScience methodology in applied research areas, and even in societal and industrial applications, will be promoted. eSSENCE will thus have a dual focus:

- *eScience for disciplinary progress in distributed research collaborations*
- *Interdisciplinary collaboration for progress in methods and tools for eScience applications.*

Within eSSENCE, collaboration for progress in eScience methods and tools will be intertwined with collaborative efforts for disciplinary progress. The capacity and support to generate benefits from such a two-way approach builds on the eSSENCE constellation forming three out of the six nodes (HPC2N, Lunarc, UPPMAX) in the Swedish National Infrastructure for Computing (SNIC), which is an essential part of the national eInfrastructure, and provides first-class computational resources and user support. Plans and strategies to further generate benefits of the proposed research involve close collaboration with seven existing Linnaeus Centres of Excellence (4 LU, 3 UU) that are represented in the body of researchers within eSSENCE, and which have their own structures of participation with industry and research institutes. In addition, the members of the eSSENCE research community represent and have leading roles in a number of other centres and research units at their home universities. It will be a priority for eSSENCE to optimize the combined conditions for scientific excellence. At the same time, it will also be a guiding principle for eSSENCE to be vigilant for short notice shifts in the eScience landscape and stay prepared for entering new areas of applications, enabling rapid progress on new large-scale distributed computer-based tools, making effective use of local and remote resources. The eSSENCE key components are:

1. **Leading edge research.** A selected number of leading research groups in physics, materials science, chemistry, biology, medicine and social sciences will be supported in their effort of using eScience even further to push for significant breakthroughs in research of fundamental importance for the understanding of nature and the functions of life.

2. **Building the tools.** First class research teams within scientific and parallel computing, computational science and computer science will develop new improved, robust and scalable tools that will help make the future impact of eScience even more dramatic.

3. **Bridging the gap.** Interdisciplinary collaboration between experts using eScience methods for scientific discovery and experts from information, communication and computational technologies will enable rapid progress and further improve Swedish eScience research at the international forefront.

4. **Leveraging computational resources.** Close contacts with the national eInfrastructure for computing will ensure that participating researchers have access to adequate, leading edge computational resources that are continuously renewed to remain state-of-the-art in hardware, software, and middleware

5. **Promoting young interdisciplinary researchers.** Creating junior research positions in the intersections between the application areas and the computational disciplines will be a high priority, thus spawning a new generation of interdisciplinary research with great future potential.

6. **Educating the future researchers.** To ensure a new generation of researchers with leading edge knowledge in eScience, eSSENCE will include the highly successful National Graduate School in Scientific Computing (NGSSC), which has admitted more than 120 PhD students since 1996.

7. **Connecting to the business sector and society at large**. From research on topics with direct importance for business and society and through local innovation systems at the partner universities, results will be rapidly brought into wider usage and possible commercialization of new inventions will be explored.

   In essence, eScience represents a distributed and collaborative research community. The current initiative of Uppsala University, Lund University and Umeå University will create a national resource for leading edge research and scientific breakthrough at all stages of the eScience process. Top-level research capabilities and eInfrastructure for advancing the eScience toolbox and for posing and solving new scientific questions within a wide range of key strategic application areas, will ensure the future benefits for society and strong scientific impacts of eSSENCE.

Attachment 2: Research Programme

2.1 Goals and vision

eScience builds on developing, implementing and using computer-based tools for performing challenging research in regimes where traditional experimental and theoretical approaches are not sufficient. eScience also builds on and provides new, unprecedented opportunities for collaboration between experts, in academia and industry, within the same and different disciplines, and over short and long geographical distances. To make significant progress, eScience is critically connected to the development of computational tools and methods and to the readiness of application areas to embrace new paradigms and attack scientific challenges from new directions.

The notion of eScience is multi-faceted. In areas like chemistry and physics, where the governing principles are well known (but too complicated to invoke in their full glory), and given in the language of mathematical models, computer simulations have been used as an indispensable tool for pushing the boundaries of science for many years. By using eScience techniques in such areas, it is possible to investigate the true nature of models and test the validity of models and effects of their inherent approximations against experiment. The ability to perform simulations has made steady progress and it has created new areas of research where large-scale computing is *the* enabling factor for understanding complex models, e.g. in climate modelling or theoretical chemistry.

Another feature of eScience is that it allows for the extraction of governing principles on a larger scale, starting from large amounts of data with little or no knowledge of the underlying patterns. This approach enables progress in a growing number of research fields, e.g. in life sciences and humanities.

*The figure illustrates our notion of eScience. As an example, consider the development of a new catalytic material to reduce pollution from chemical industry (**outermost circle/cogwheel**). A controlled and knowledge-based development of such a material requires a molecular-level understanding of the reaction in the catalytic converter Large-scale chemistry simulations (**outermost but one circle**) can produce such detailed understanding – provided that the mathematical models used in the simulations represent the laws of chemistry to a sufficient level of accuracy (**innermost but one circle**) and provided that the fundamental eScience methods, tools and software are efficient enough to enable such large-scale simulations (**innermost circle**). The vision of eSSENCE is to enhance the flow of information between these four levels, to achieve more robust an efficient eScience tools, enabling novel science and breakthrough results.*
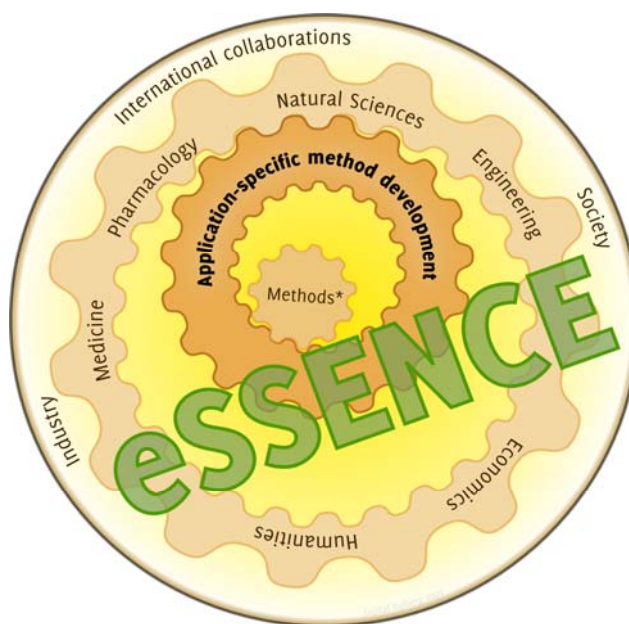
The eSSENCE Foundation: UU, LU and UmU will act together to establish the eSSENCE initiative as a highly visible forerunner in the eScience field and to carry it through to success. The initiative builds on established excellence in a complete span of eScience research areas and in eScience education, strong connections to eInfrastructure, clear and strong university strategies and efforts within eScience research and education, and existing collaborative structures.

The overall goal of eSSENCE is to create a digital research community and dynamic environment with top-level research capabilities by providing excellence, renewal and innovation at all stages of the eScience process

The figure illustrates the eSSENCE view of the eScience process. Accurate computer-based models are formulated, robust and efficient implementations enable computer-based experiments for complex problem settings, and computer-based tools provide means for communicating and interpreting ideas and research results.
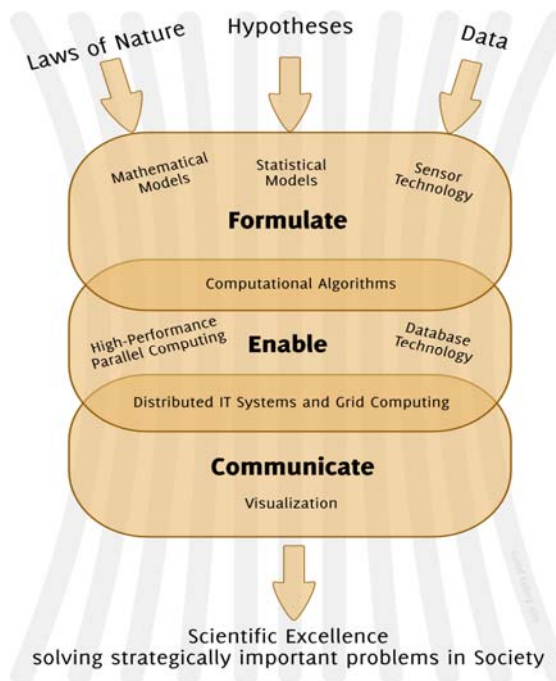
The Vision of eSSENCE is to create an eScience environment where an increased awareness among the different eScience actors – in applications, tools, infrastructure development and education – will lead to a much more efficient interplay between the competences and open up the field for novel applications, more realistic simulations, new scientific solutions, and unprecedented excellence in Swedish eScience

The eSSENCE Mission: The key ingredient for achieving the overall eSSENCE goal is a strong focus on *aspects of collaboration and cross-fertilization*, from two points of view:

- *eScience for disciplinary progress in distributed research collaborations*
- *Interdisciplinary collaboration for progress in eScience methods and tools*

Within the initiative, the latter kind of collaboration will be intertwined with efforts of the former kind. Building on this two-way approach and on strong national eInfrastructure, eSSENCE will provide novel opportunities for groundbreaking progress in *both* a spectrum of fields where eScience is used for scientific discovery *and* in research on eScience methods, tools and techniques.

2.2 Scientific Excellence and Resources

The eSSENCE initiative hosts excellence and vast experience in a complete spectrum of eScience aspects. The eSSENCE groups in eScience application areas at UU and LU have all been relying on eScience technology in their daily activities for many years, and they have extensive experience in developing and implementing novel eScience tools for challenging research problems in their fields of interests. All these groups are identified as being *world-leading* or of *high international standard* in the recent international evaluations of research at these two universities (KoF and RQ08), and they have been carefully selected by the universities also to be of strategic importance to industry and society. Furthermore, eSSENCE includes excellent groups focusing on efficient and accurate models, algorithms and software for large-scale parallel computer systems, grid research and middleware development, database techniques, and image analysis. An important criterion for the selection of groups in this initiative has been the potential to form a strong and coherent multidisciplinary research environment, encompassing all stages in the eScience research process, and ensuring that complementary scientific skills are pooled while unnecessary duplication is avoided.