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TEKNAT 2017/81

Research Strategies for the Faculty of Science and Technology 2017-2021

This document supplements the Uppsala University Research Strategies (UFV 2016/118) and formulates the Faculty's approach to achieving world-leading research

Adopted by the Faculty Board on 14 November 2017

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Introduction

The Faculty of Science and Technology has the following vision, formulated in Mission and Core Values of the Faculty of Science and Technology (TEKNAT 2015/6).

New knowledge – new applications – new expertise

We will conduct research and education of the highest international quality to expand our knowledge and to meet the needs of humankind today without jeopardising our environment and future generations' opportunities to meet their needs.

We will conduct pure research and applied research aimed at continuous advancements and new breakthroughs.

The Faculty's courses and programmes will link to prominent research, build on modern educational development, promote the personal development of students and take into account the needs of society.

The Faculty at large will be an attractive partner for collaborating with companies, organisations, society and higher education institutions in Sweden and abroad.

This document aims to formulate the Faculty's approach to achieving its vision of world-leading research. The document is based on Uppsala University's Research Strategies 2016-202 and the Action Plan for the Faculty of Science and Technology (TEKNAT 2015/6). The Faculty of Science and Technology's research is a cornerstone for Uppsala University, where research and education are continuously evolving and finding new paths.

The Faculty's researchers conduct pure, long-term, curiosity-based and applied research. This research contributes to solving society's challenges through increased knowledge and innovation. From the Faculty's perspective, there is no contradiction between pure and applied research; what is crucial to the quality of research is the researchers' own free choices, ideas and problem formulations. Long-term competence building and space for risk-taking in research pave the way for new breakthroughs and innovations. This base also makes it possible for the Faculty to graduate a large number of highly educated students and PhDs in engineering and technology and natural sciences who contribute to deepened knowledge development in society at large.

The Faculty's research will continue to be unrestricted and based on the researchers' own choices. There is a need for sufficient basic funding at the doctorate level to enable positive and dynamic advancement, particularly in order to quickly develop new areas – preferably in interfaces with already established areas. Society is facing a great number of critical challenges (climate changes, natural disasters, antibiotic resistance, energy supply, raw material supply and IT security, to name just a few) that require international and national efforts to which research in the Faculty of Science and Technology can contribute with knowledge and solutions. For the research community,

it is important that challenging calls from financiers and public authorities are open and transparent and that they are based on respect for the research community's own research formulations in order to enable the highest possible quality of research.

A Faculty of its time

The Disciplinary Domain of Science and Technology is comprised of a single faculty, which is the largest in the country. Its research has a turnover of over SEK 1.7 billion and is 55 per cent externally financed. The Faculty is divided into six sections: biological sciences, physical sciences, earth sciences, chemical sciences, mathematics/data and engineering and technology. Each section contains one or more departments. The Faculty has 60 research programmes distributed over 10 departments. Each research programme has a critical mass of senior and younger teachers and researchers to create a first-rate research environment. In dialogue with Faculty management, programme performance is followed up annually, and the Faculty Board decides on any re-prioritisations and new initiatives.

Five pillars for the Faculty's work

"Research freedom is important because it makes possible the unexpected that renews our world view or lays the foundation for the development of new technologies – major breakthroughs lead to major societal benefits over the long term"[1]. The Faculty continuously reformulates its priorities, but its long-term strategies aim at utilising researchers' ideas and paving the way for new areas of research. The Faculty of Science and Technology's strategies and considerations over the next five-year period rest on the following five pillars: Quality, Skills provision, Internationalisation, Collaboration and Research infrastructure.

Quality

The overall goal is to contribute with top-quality research in all areas of the Faculty. The Faculty's research is characterised by internationally high standards, which is supported by two of the University's Quality and Renewal evaluations (KoF07 and KoF11), in which 90 research environments within the Faculty were identified as internationally prominent[2]. World-leading research teams are found in all of the Faculty's sections. The Faculty's researchers are successful in attracting national and international funding, which is demonstrated in a high proportion of ERC grants, Wallenberg Academy Fellows, a large number of KAW project grants, the strategic research domains and international recruitment of researchers.

[1] Mission and Core Values of the Faculty of Science and Technology

[2] The groups that were awarded one of the two highest ratings by international assessors, "Top-quality/World leading" or "Internationally high standard", in KoF11/Quality and Renewal 2011

Quality is upheld by:

- The researchers formulating the content of the research. The Faculty aims to sustainably uphold the freedom of pure and applied research that stems from the researchers' own ideas and knowledge requirements, and promote risk-taking for new knowledge.
- The Faculty conducts systematic quality enhancement activities on all levels – from the first year of education to world-class research. In dialogue with Faculty management, the performance of the programme is followed up on an annual basis, and the University's third international evaluation with collegial assessment (Quality and Renewal, KoF17) was implemented in 2017, with the aim of strengthening the conditions and processes that promote research quality and renewal.
- The Faculty upholds a stable base with strong research-integrated education, pure research and engineering intrinsic to the field of enquiry, with a mixture of theoretical and empirical working methods and approaches. Scientific excellence is also fostered through strategic co-financing.
- The Faculty's activities are pervaded by a work culture that promotes gender equality and equal treatment in order to utilise all skills and expertise.
- The Faculty ensures the quality of education through a strong connection to the latest research in teaching and through subject didactics research.
- The Faculty takes a particular responsibility in developing strategic research domains such as CNDS (Centre of Natural Hazards and Disaster Science), eSSENCE and STandUP for Energy.
    - CNDS – a national knowledge centre for natural hazards and disaster science, which conducts research aimed at enhancing society's ability to prevent and manage risks, both within Sweden and abroad. The research provides a greater understanding of the dynamics and adverse effects of natural hazards, as well as Swedish crisis preparedness and vulnerability.
    - eSSENCE – a leading research environment in subject-specific e-science research (biology, computer science, physics, chemistry, etc.) that promotes transdisciplinary, national and international research alliances.
    - STandUP for Energy – a leader in energy research in the areas of renewable energy production, distribution, storage and electrical and hybrid vehicles.

Skills provision

Competitive recruitment depends on the Faculty being perceived as an attractive research environment with high international visibility. All employment positions are advertised internationally with broadly designed announcement descriptions. The Faculty works systematically to promote dialogue in the departments on matters such as generational shift and recruitment in order to ensure good skills provision. Other important factors for skills provision include clear career paths, mobility and gender equality. The Faculty works to ensure:

- Clear career paths for young employees, with the requirement for individual career development plans for associate senior lecturers.

- That mobility is fostered through recruitment and acquisition of qualifications. The Faculty encourages international exchange for senior researchers via the University's international network and facilitates the reception of visiting research fellows.
- Balanced gender distribution among employees and students. Openness and transparency have proven to be key tools to increasing gender equality, as has broadly formulated employment announcements.
- Equal opportunities for women and men to acquire further qualifications, both at the postgraduate level and later in their research careers. Through a mentoring programme to support young researchers in the beginning of their careers, the Faculty strives to achieve a more even gender distribution among senior lecturers and professors.
- In those research domains with a very uneven gender balance, the department is encouraged to actively identify and inform potential candidates of the under-represented gender about new employment positions.
- Employees with foreign backgrounds are offered courses in Swedish to help enable them to fully integrate among the staff, teach at the undergraduate level and participate in planning boards, committees and decision-making bodies.
- The strategic research domains have a particular responsibility to increase gender equality.

Internationalisation

The Faculty's research activities are international by nature. Forty-five per cent of the Faculty's researchers were born outside of Sweden and sixty per cent of publications are collaborative works with research teams outside of Sweden. Researcher exchange and international collaboration are initiated by both individual researchers and research teams as well as at the University and Faculty level. The Faculty's international collaborations are extensive and are not listed here.

In addition, the Faculty will develop and increase participation in international networks through:

- Strategic partnerships with selected higher education institutions abroad.
- Increased participation in the Horizon 2020 programme. The Faculty's EU coordinator will actively facilitate this work.
- Actively participate in international and University-wide collaborations such as the Baltic University Programme, GUILD[3], LU-UU-FAPESP[4], MIRAI[5], U4[6], Coimbra and Matariki networks.
- The development of international research programmes/courses that highlight future global challenges and possibilities. In this context, utilise the limitless possibilities of the Internet.

[3] The Guild of European Research-Intensive Universities

[4] Research collaboration with The São Paulo Research Foundation in Brazil

[5] Collaborative agreements with a number of Japanese higher education institutions.

[6] A strategic partnership between the universities in Ghent, Göttingen, Groningen and Uppsala University.

- The continuous development of recruitment strategies to connect us to the best international talents.
- The facilitation of long research sojourns abroad for the Faculty's researchers.
- Enhanced cooperation with the Faculty's adjunct professors at higher education institutions abroad.
- The development of our initiatives and participation in international infrastructure collaborations.

The Faculty also contributes to long-term scientific capacity building in low-income countries through the International Science Program (ISP), which strengthens research capacity and postgraduate education in e.g. biology, earth sciences, chemistry, physical sciences and mathematics.

Cooperation

The goal is to develop forms of cooperation that make researchers and postgraduate students at the Faculty knowledgeable about innovation issues and society's needs in order to influence societal developments toward a better world.

The Faculty's researchers and postgraduate students cooperate actively with the private sector and the surrounding community, which provides mutual benefit and is of great importance to the Faculty's activities. The Faculty collaborates with small and large companies, with museums, as experts and advisers for public authorities, as well as through outward-looking activities. For the Faculty's researchers and for research-based education, the established partnerships with ABB, NCC, RISE and the Municipality of Uppsala provide tools for deeper cooperation on key research issues. ÅMA[7] and AIMday offer companies and organisations a forum to address relevant and business-related issues in various areas with the Faculty's researchers. Education and outreach activities with the surrounding community such as SciFest, school projects, open lectures on current themes and activities surrounding the Nobel Prize are other key forms of cooperation that are being continuously developed. One strategic innovation area (SIA), the Internet of Things, with its programme office in the Faculty, is one collaboration area for which the Faculty is responsible. Participation in SIOs is strategically important for the Faculty as a means of increased collaboration between researchers, companies and the surrounding community. Upptech is the Faculty's initiative to promote research and education in technology at Uppsala University. One of the goals of Upptech is to increase cooperation between researchers and students with external actors in the community and private sector.

Strategies to increase collaboration within the Faculty's spheres of activity are:

- Strengthening strategic partnership and planning additional strategic partnerships to strengthen the Faculty's breadth and innovation power.

[7] Ångström Academy

- Developing partnerships so that industry leadership resources promote mutual knowledge building between the private sector and academia.
- To develop such cooperation with UU Innovation and research patents to offer faculty researchers support for collaboration and innovation. The Faculty holds memberships in EIT[8] and their innovation programmes RawMaterials, Health and InnoEnergy.
- Supporting innovation and cooperation with the surrounding community as a consequence of the Faculty's focus on national research infrastructure.
- Developing contacts with local upper-secondary schools through the participation of researchers in teaching, as well as by continuing the professional development of upper-secondary school teachers throughout Sweden and thereby ensuring that the latest research findings are conveyed at the upper-secondary level and that subject didactics skills are strengthened.
- Facilitating the mission of the strategic research domains to strengthen cooperation within their respective domains.

Research infrastructure

Access to powerful and modern research infrastructure is a prerequisite for the Faculty's researchers to be able to conduct excellent research and research-based education.

Research infrastructure includes facilities, workshops, tools and services and is designed to be used by researchers or research groups in pure research or applied research. This also includes e-infrastructure for the calculation, management, storage and analysis of research data. Research infrastructures may be centralised, distributed or virtual. Research infrastructures can also be built, operated and provided at different levels: within a research team, a department, a faculty, a higher education institution, nationally or internationally. Activities at the Faculty can also in many cases contribute research and development to building new infrastructures or infrastructure components. Research infrastructures also provide a strong platform for cooperation with society.

Research infrastructure in research programmes and at the department level

The research programmes and departments are responsible for the strategic development and operation of their local infrastructures and their participation in national and international infrastructure collaborations. In order to facilitate coordination and identify opportunities and shortcomings , the Faculty will continuously document this landscape of local infrastructures and external cooperation.

In order to meet the need for adequate local infrastructure, the Faculty will place particular importance on:

- Highlighting existing infrastructure and how it can be used.

[8] European Institute of Innovation and Technology

- Encouraging coordination between research programmes and departments to ensure the financing and development of local infrastructure.
- Ensuring that infrastructure is used and is available to the furthest extent possible.
- Developing processes surrounding local e-infrastructure for calculation as well as management, analysis and archiving of research data. This is needed both to meet the needs of research and to meet demands from financiers and the government on our activities. The development of processes and resources for research data will be governed by research needs and led by research activities.

Research infrastructure at the Faculty level

Some infrastructure within the Faculty and some University-wide, national and international infrastructure collaborations in which the Faculty participates can be deemed to be of Faculty-wide interest. Such infrastructures normally meet the following criteria:

- Provide the conditions for leading research.
- Are utilised by a number of research teams within the Faculty and have users with highly qualified research projects.
- Are so extensive that individual groups cannot run them on their own.
- Have long-term planning for scientific targets, financing and utilisation.
- Are open and easily available to the Faculty's researchers, industry and other stakeholders.
- Have a plan for availability (in terms of use of the infrastructure, access to collected data and presentation of results).

To support cooperation within the Faculty and with other actors, the Faculty will implement a strategic framework for infrastructures (local, national and international) that are of Faculty-wide interest. Within this framework, the Faculty will maintain a list of such infrastructures and develop a life-cycle analysis that includes periodic review of infrastructure development, including planning, implementation, operation, and upgrading/shut-down.

National infrastructure

The Faculty of Science and Technology holds a strong position in various national infrastructures and leads several of these. National infrastructures can be divided into five groups: E-infrastructure, MAX IV, National field infrastructures, SciLifeLab, and Other national infrastructures.

E-infrastructure

Through the University's hosting of SNIC[9] and the local data centre UPPMAX[10], the University and the Faculty are already taking great responsibility for national e-infrastructure. The use of SNIC's national resources, both for calculations and for storage/management of data, is extensive. The Faculty will use this central position to:

- Further strengthen involvement in the building and coordination of national e-infrastructure adapted to research needs.
- Further enhance coordination between international, national and local e-infrastructure to contribute to effective research and facilitate participation in national and international research cooperation.
- Promote skills for efficient use of e-infrastructure.
- Further develop software and databases.

MAX IV

The Faculty's researchers constitute a major MAX IV user group, and also drive the development of future beamlines at MAX IV. Sweden is currently investing major resources in this infrastructure, and the Faculty will contribute by:

- Strengthening the national and international position as a strong centre for synchrotron light research.
- Enhancing and developing the skills of photon science to take advantage of the opportunities MAX IV will offer, through the Centre for Photon Science.
- Broadening the user base and promoting awareness of experimental synergies between MAX IV and ESS.
- Contributing to future developments of new beamlines at MAX IV.
- Working to ensure that courses and educational opportunities in photon science are available at all levels (master's, PhD and researcher/senior lecturer).

National field infrastructures

The Faculty's researchers are active users of field infrastructures and also drive method and technology development. Research carried out within these areas is central to national research policy and relates to e.g. basic ecological and evolutionary conditions, climate change, natural disasters and sustainable development. The Faculty will contribute by:

- Strengthening the national and international position with our extensive expertise in geodetical surveying (distribution and station measurements).
- Continuing to systematically store and make available the data generated at these field stations.

[9] The Swedish National Infrastructure for Computing

[10] Uppsala Multidisciplinary Center for Advanced Computational Science

- Strengthening our expertise in field-based instrument development.
- Promoting knowledge about field infrastructures and promoting synergies in different parts of the Faculty.

SciLifeLab

SciLifeLab is a national centre for molecular biosciences with a focus on research in health and the environment. A large number of researchers at the Faculty are users of different technology platforms at SciLifeLab and many are also involved in the operation of these. Sweden is currently investing major resources in SciLifeLab, and the Faculty will contribute by:

- Strengthening SciLifeLab's national and international position as a strong centre for knowledge and technology in molecular biosciences.
- Contributing to future developments of new technology platforms at SciLifeLab.
- Ensuring that courses and educational opportunities in molecular biosciences are available at all levels (master's, PhD and researcher/senior lecturer).

Other national infrastructures

- Encouraging participation in the national infrastructures deemed to be essential for the Faculty's research. This concerns both utilising the available technologies and developing new technologies.
- Working for the sustainable development of MyFab[11]/MSL[12] as a technology platform for materials science in a broad sense.
- Developing processes for prioritising the national infrastructure in which the Faculty is engaged in.
- Working for the unique expertise available at Uppsala University by developing the Ångström Workshop, the FREIA[13]Laboratory and systems thinking into a national infrastructure for instrumentation.

International infrastructure

The Faculty is well positioned in major international infrastructures such as CERN, FAIR[14], ESO[15] and in various ERICs[16] (e.g. ICOS[17] and EPOS[18]). The Faculty is also

[11] Swedish national research infrastructure for micro and nano fabrication

[12] Ångström Microstructure Laboratory

[13] Infrastructure for research and development of new particle accelerators and instrumentation for research on particle accelerators

[14] The Facility for Antiproton and Ion Research

[15] The European Southern Observatory

[16] European Research Infrastructure Consortium

[17] Integrated Carbon Observation System

[18] The European Plate Observing System

well positioned in the development of instruments and beamlines for various international infrastructures such as ILL[19], Bessy[20] and ESS[21]. The faculty's researchers are very competitive in gaining access to measuring time. In order to strengthen Swedish researchers' ability to influence in international arenas, the Faculty will actively support local research initiatives by promoting their involvement in different impact groups.

ESS

The faculty's researchers have good prospects for developing a user group with the skills to utilise the opportunities for research that ESS will offer. The Faculty has established a Centre for Neutron Science to support this science. To create readiness for ESS, the Faculty will:

- Strengthen and develop expertise in neutron scattering so that more and new areas are familiar with the tools.
- Broadening the user base and promoting awareness of experimental synergies between MAX IV and ESS.
- Ensuring that courses and educational opportunities in neutron scattering are available at all levels (master's, PhD and researcher/senior lecturer).
- Taking responsibility for ensuring that researchers and companies from other organisations acquire knowledge on the possibilities ESS offers.

[19] Institut Laue-Langevain

[20] Berlin Electron Storage Ring Society for Synchrotron Radiation

[21] European Spallation Source