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UNIVERSITET

Dnr 2016/117

Uppsala University Research Strategies 2016–2020

Adopted by the University Board, 26 October 2016

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Foreword

Uppsala University stands well equipped to meet the challenges of the future. Research carried out here helps us to understand our society, makes the world a better place and makes life easier for many people – research that provides new perspectives on fundamental scientific issues and knowledge that contributes to environmental sustainability, human health and the development of society. Our complete academic environment and strong educational tradition give us the courage to try out new paths. The University defends the long-term pursuit of knowledge to add to the collective learning of humanity and to global development. Research proceeds both from the major challenges facing society and from issues intrinsic to the field of enquiry. At the same time, research goes hand in hand with education and collaboration with the external community. Academic excellence, openness and social benefit are mutually reinforcing.

In “Uppsala University Research Strategies 2016–2020” we formulate strategies that create good conditions for quality and renewal in the long term. The strategies are part of the University’s input to the Government’s 2016 research bill. The document follows up and deepens the objectives and main lines of research strategy expressed in *Uppsala University: Mission and Core Values*.

The strategies describe existing strong research areas in which we have conducted major initiatives in recent years. We also identify new challenge-led research undertakings where our broad expertise can contribute to new knowledge. Uppsala University has the will and the determination to drive progress for the benefit of individuals and society.

Eva Åkesson
Vice-Chancellor

Success factors for a broad research university

Uppsala University is a regional, national and international meeting place for knowledge, culture and critical dialogue. The University's strategies for research and higher education are based on a tradition of scholarly excellence, the idea of social benefit and the potential of a full-scale university to bring expertise and actors together in new combinations. We uphold quality, breadth and equal opportunities. These are essential conditions for continuing to develop with ambition and integrity and successfully attracting the best researchers, teachers and students.

Particular emphasis is given to four factors for success:

- Researchers personally define the content of their research on the basis of current scholarly and social challenges. New perspectives are identified to address the most interesting and challenging questions in the field.
- A strong financial base makes it possible to set strategic priorities and mobilise joint efforts.
- The University's management stands ready – and has a mandate – to recognise new, emerging areas of scholarly inquiry, and to create space for them. Special resources are channelled to these areas.
- Complete academic environments with critical mass are created where people are given an opportunity to grow in expertise and maturity as natural members of the international scholarly community. Education is a natural and integral part of the University's scholarly environments.

Complete academic environments

Uppsala University is a research university where the combination of depth and breadth in multiple disciplinary domains can create strong environments for research and education. In many of these environments, world-class research is conducted.

- The latest research evaluation at Uppsala University identified nearly *200 internationally leading environments and research groups*¹. They advance the boundaries of our knowledge and offer new perspectives on issues ranging from our origins to our own time, nature and future. Together they lay the solid scholarly foundation that is an essential condition for research breakthroughs, innovations and preparedness for the unexpected.
- Education at Bachelor's, Master's and PhD levels (first, second and third cycles) is systematically integrated with the University's research and external collaboration. The scholarly foundation of education, including programmes closely linked to practical application, is emphasised in decisions on educational profiles and research priorities. Students are given access to research infrastructure, and research staff participate in education at all levels.
- Attractive and functional campus environments facilitate cross-disciplinary encounters between researchers. The University has a conspicuous presence in its urban setting and is open to the world around it. This dimension will develop further in 2016–2020 with the construction of the Humanities Theatre, a unique arena for unbounded discourse. Nya Ångström will serve as a centre for the University's focus on technology. The Segerstedt Building, which is currently being erected, will provide a new hub for management, support, student services and coordination. The Rudbeck Laboratory and the new '100 Building' at Uppsala University Hospital bring together clinical and translational medicine with a special focus on cancer.
- Research is supported by well-qualified technical and administrative staff, who work closely with researchers in the pursuit of knowledge development. Special support functions act to strengthen researchers' involvement in EU projects, external collaboration and internationalisation.
- UU Innovation vigorously supports the development of new products, methods and businesses. The innovation system and collaboration platform STUNS includes the successful business incubator Uppsala Innovation Centre².
- Uppsala University is developing its activities at Campus Gotland for the long term. The combined resources of Visby and Uppsala constitute leading academic environments in areas of expertise such as archaeology, conservation and art history, and in the area of sustainable development.

¹ Groups receiving one of the two highest ratings from international experts in *Quality and Renewal 2011*, 'Top-quality/World-leading' or 'Internationally high standard'

² In 2015 Uppsala Innovation Centre was ranked fifth in Europe and tenth in the world by UBI Global.

Four prerequisites provide stability and direction

Quality

Quality and renewal are key words in Uppsala University's systematic efforts to strengthen its position as an internationally leading research university. Three strategies lay the foundation for the culture of quality that animates every aspect of the University's activities:

- High-class research environments are created by uniting the pursuit of scholarly excellence with benefit to society, and by integrating research and education.
- Systematic quality assurance and enhancement is conducted at all levels of the organisation. International evaluations including peer review are an important feature that recur periodically and underpin development efforts. They are intended to strengthen the preconditions and processes that promote research quality and renewal.
- Excellent research is closely linked with high-quality education. Uppsala University is currently developing a model for the systematic evaluation of education.

Infrastructure

Successful research depends on infrastructure of an internationally high standard in the form of experimental equipment, databases, libraries, collections and biobanks. Uppsala University hosts various infrastructure resources that are accessible nationally and internationally, and by the same token, researchers at the University make extensive use of infrastructure elsewhere in Sweden and abroad. The following resources are of particular strategic importance:

- SciLifeLab offers a wide range of experimental facilities to support research in health and environmental sciences with a molecular focus. The Swedish National Infrastructure for Computing (SNIC), which is coordinated by Uppsala University and makes resources available for calculations, analysis and data storage, is also of major importance.
- Uppsala University researchers are the largest group of users at Max IV and are contributing actively to the building of ESS – not least through leading expertise in construction and engineering. Uppsala University intends to establish an on-site office at Science Village in Lund to enhance opportunities for researchers at the University to visit Max IV and ESS.
- The infrastructure resources needed by researchers continue to receive priority. The University has world-leading resources in important profile areas at local level, e.g. the Uppsala Conflict Data Program. Information provision is in focus in the development of the University Library as an infrastructure resource for research and higher education for the entire University. For future needs, the University is working on priorities across disciplinary boundaries in national dialogue.
- Uppsala Clinical Research Center (UCR) is an infrastructure resource for clinical research with an excellent international reputation, for which Uppsala University and Uppsala County Council share responsibility. It hosts expertise in all stages of clinical studies, world-leading infrastructure for health registers and associated research, and a well-functioning biobank for both healthcare and research needs.

Internationalisation and the world around us

Uppsala University is open to the outside world and participates proactively in international contexts centring on new knowledge. Collaboration with international actors and financiers is being strengthened. Researchers and teachers are encouraged to take on leading roles in national and international scholarly relations. The following principles are important:

- Uppsala University is systematically seeking increased participation in EU projects and consortia. Project coordinators with a good knowledge of the EU have been recruited to support researchers involved and contribute to closer dialogue with decision-makers and partners.
- Uppsala University takes responsibility in international contexts where scholarly expertise is needed, for example in work on the 2030 Agenda and in various UN bodies. The University is also making a long-term contribution to scientific capacity-building in low-income countries.
- Areas that demand new knowledge and innovation are identified in collaboration with important actors in society. Researchers and teachers at Uppsala University collaborate actively with the business and civic sectors and contribute to the implementation of new knowledge in fields such as medicine, energy technology, biotechnology, psychology and law. A Collaboration Council has been established as a strategic resource for the entire University and 'strategic partnership' agreements are being entered into with particularly important actors.

Skills provision

Innovative research requires independent, innovative researchers. The equal opportunities perspective is highlighted in all recruitment processes and is an integral component of all training for managers. Available tools for strategic skills provision are systematically applied and vacancies are advertised internationally. Strategic actions include:

- Employees in the early phases of their career receive support through mentorship, advice in formulating applications and interview training. Appointment as an associate senior lecturer is used as an entry-level position in a research and teaching career.
- Uppsala University recruits actively in strategically important areas. New employees and visiting researchers recruited internationally are offered support to help them become established. Mobility and international experience are to be taken into account when recruiting younger researchers.
- Skills development programmes facilitate new career steps. Management training is obligatory for heads of department, as are courses in university teaching for teachers and courses in supervision for PhD supervisors. Skills development for senior academic managers is arranged in cooperation with international partner institutions.

Areas of strength and new initiatives

Uppsala University stands out for its multiple areas of academic strength in which research, education and collaboration are integrally connected. This integrated approach applies along the entire chain from fundamental theory and experimental research to practical application through innovative ideas and perspectives with the potential to change society. Quality and a capacity for renewal have manifested themselves over the years in increased welfare, better quality of life and new businesses. Good results are confirmed and reinforced by quality assessments and awards of external funding following peer review and in competition with other institutions.

Energy and sustainable development

In this area, the focus is on renewable energy, energy systems, sustainable use of natural resources, environmental and climate research, and sustainable social development. It includes two designated strategic research areas, as well as participation in cooperative projects for innovation and sustainable social development:

- **STandUP for Energy** is a strategic research area predicated on a global energy system perspective. The long-term objective is to reduce the cost of large-scale, renewable, environmentally sustainable electricity, delivered to the end user via the electricity grid, and the development of more cost-effective and energy-efficient hybrid and electric vehicles.
- **The Centre for Natural Disaster Science** is a multidisciplinary knowledge centre in which research contributes to a better ability to prevent and deal with risks in society, nationally and internationally. The research produces a better understanding of the dynamics of natural events and the damage they cause, and of Sweden's crisis preparedness and vulnerability.
- **KIC InnoEnergy** and **EIT Raw Materials** are two European platforms that emphasise new technology, new expertise and new methods at a cross-society, systemic level.

The digital society

The quantity of digital information in society is increasing exponentially. This trend is reinforced by initiatives seeking to secure open access to jointly funded digital resources. The needs are evident in all research disciplines. High-tech industry, the financial sector, the experience industry and the care sector are increasingly dependent on advanced IT tools that build on mathematical and statistical models and computer-based calculations. Uppsala University is well equipped to play a role where new and emerging needs make unprecedented demands for tools and cooperation between researchers, research infrastructures, university libraries and other actors in society. Important platforms include:

- **eSSENCE** is a strategic research area where specialists in applying eScience methodologies in specific subjects cooperate with specialists in the development of new eScience methods and tools. The research area is multidisciplinary and is developing very rapidly.

- **UPMARC** is a world leader in developing effective, correct and energy-efficient software and embedded systems. The research area is closely associated with technological development and results are rapidly translated into applications.
- **The Internet of Things (IoT)** is a strategic innovation programme. The objective is to make Sweden best in the world by 2025 at reaping the benefits of IoT. IoT means that everyday devices are equipped with embedded sensors and processors. They can sense their surroundings, communicate with them and contribute to creating smart, attractive and helpful environments, goods and services.

People, culture and society

The social and cultural dimensions of the challenges facing society are obvious. Knowledge about human behaviour, power relations, communications, lifestyles and norm-setting plays a key role for society's ability to deal with complex future issues. Research in the humanities and social sciences addresses the formation of people's ideas and knowledge in specific times and places, together with the economic, political, social and cultural aspects of the development of society. It explains the causes and consequences of people's interaction and the organisation of society. Research in the humanities and social sciences provides society with knowledge in areas such as education, languages, migration, national and international relations, history and cultural heritage, media developments, politics and public institutions, the development of prosperity and economics, sustainability and social health. Uppsala University is home to initiatives with a special focus on:

- **Peace, security and democracy** – Uppsala University has platforms of expertise in peace and conflict research, international relations and the strategic research area **Centre for Russian and Eurasian Studies**.
- **Uppsala Religion and Society Research Centre** – The IMPACT of Religion – addresses the economic, social, political and above all religious changes that are taking place in Sweden and the other Nordic countries at the beginning of the 21st century. Legal expertise adds an important dimension in elucidating the significance of religion.
- **Uppsala Center for Labor Studies** conducts research in three main areas: labour market relations; unemployment and social security; and income, education and school issues. It brings together researchers in economics, political science and law. It collaborates closely with the Institute for Evaluation of Labour Market and Education Policy.
- **Languages, culture and communication** – Language is a prerequisite for individual and social development. To meet the national and global challenges of our time, cutting-edge skills are needed in individual languages together with a scientifically based knowledge of how communication works. Uppsala University has a unique research environment for language studies, with over 40 languages and linguistic subjects. The range of languages offered is the greatest in Sweden and the University intends to further strengthen this area.
- **Interdisciplinary infrastructure platforms**, e.g. the digitisation platform **Alvin**, and high-quality collections that welcome researchers and students, strengthen the scholarly environment. They are used systematically as a resource for students' career development through internships principally attached to educational programmes in the humanities.

Life and health

Our health is one of the major challenges facing society. Both preventive measures and better care of those who are already sick depend on increased knowledge of the mechanisms underlying diseases and the development of new diagnostic tools and treatment strategies. Taking a whole person approach, Uppsala University strategically brings its concentrated resources to bear in the life sciences including pharmaceuticals, medicine and health:

- **Science for Life Laboratory (SciLifeLab)** is a national hub for molecular biosciences with a focus on health and environmental research. It brings together leading expertise with advanced knowledge in translational medicine, molecular biosciences and environmental science. SciLifeLab also has substantial infrastructure resources for genome sequencing (NGI), bioinformatics (NBIS), pharmaceutical development and visualisation, e.g. PET/MR.
- **The major health scourges** – cancer, diabetes, dementia, autoimmunity and cardiovascular diseases – are important areas in which Uppsala University has created successful research environments. This research is based in part on biobanking and large quality registers. In addition, studies and surveys are in progress charting the mechanisms underlying diseases and investigating diagnostic tools and treatment strategies at cellular and molecular level. **U-CAN, EpiHealth** and **SCAPIS** (Swedish CArdioPulmonary bioImage Study) are examples of major initiatives in these areas where Uppsala University has a leading role. New methods are also being developed here for conducting randomised clinical trials using quality registers, an approach that has attracted international attention.
- **U-CARE** is a strategic research environment in caring sciences with a focus on the psychosocial effects of serious and life-threatening illnesses. The environment has been built up around the development of a patient–healthcare professional interface, models and software.
- **Life science cluster** and **EIT Health** – Business start-ups, commercialisation and implementation of new knowledge are emphasised in an internationally competitive hub focused on life sciences. EIT Health aims to strengthen society in the long term by promoting personal health, with a particular focus on the ageing population. The initiative Uppsala Health Summit influences decision-makers and other actors in society.
- **Pharmaceutical development** – The development of functional and safe pharmaceuticals is key to effective medical treatment. Identifying biomolecules and their role in disease processes creates new prospects for diagnosing diseases and treating them with pharmaceuticals. Uppsala University is a key actor in the SciLifeLab Drug Discovery and Development (DDD) platform. Major development areas include pharmaceutical chemistry and pharmacy, calculation methodology for the simulation of chemical and biological structures and processes, the use of cell-based methods, effective strategies for clinical pharmaceutical development, and product design and production.

Nature and evolution

Knowledge about the building blocks of nature and natural phenomena lays the foundation for human understanding of the fundamental structure of our world and the processes by which it develops. Research extending the limits of the knowable offers rich opportunities for the development of theories, models and new technology. Some examples are:

- Knowledge about the properties and structures of materials leads to an ability to tailor functionality with high precision in broad fields such as **nanotechnology** and **biomaterials**.
- Evolution and diversity are central to world-leading research at the **Evolutionary Biology Centre**, including **Human Diversity**, and the Linnaeus environment **Uppsala Centre of Evolution and Genomics**.
- Uppsala University participates actively in international projects such as **IceCube** and is engaged in Uppsala itself in developing and constructing components for 'Big Physics' within the framework of the **FREIA Laboratory**.

Themes for planned challenge-led research initiatives

In the coming years, Uppsala University intends to prioritise a number of areas of future importance stemming from internationally leading research. The priorities have emerged in dialogue with society and activities are conducted in collaboration with national and international actors from various sectors of society.

Antibiotic resistance

Effective antibiotics must be available in future too. Research at the newly established Uppsala Antibiotic Centre (UAC) will aim for deeper knowledge in areas as diverse as the development of resistance by bacteria, the use of available antibiotics and the development of new antibiotics (both in human medicine and in animal husbandry). The influence of culture and other society-related drivers on antibiotics use, and ways of changing ingrained patterns of behaviour, will also be studied. Through the IMI projects ENABLE and DRIVE, Uppsala University is participating in the development of new antibiotics and the development of new business models in the area of antibiotics.

Our digital future

Research and education in the analysis and management of large quantities of information from different sources has a key role in the future development of society. Digital humanities is being established as a new branch of research, while technological developments offer unprecedented opportunities for creating and managing information. To be able to fully harness the enormous quantity of information that is becoming available, new research is required into the ways in which data is turned into knowledge, and new IT tools are needed that enable practical application, e.g. in the education sector.

The new world of work

The modern world of work, with its new demands and challenges, is a key research area today. New work environment problems have grown up around stress and mental ill-health. Increased demands for flexibility and more temporary employment positions are changing the playing field at workplaces and for individuals. The question of how to promote everyone's participation in the world of work is significant for society as a whole.

eHealth

Technological progress allows people to read their medical records online, enables surgeons to operate remotely and makes it possible to identify the activity of individual brain cells. In future there will be great opportunities to improve and simplify patients' medical care both at home and in care facilities by digital means. The development of new methods for transferring clinically relevant data (such as blood pressure and blood sugar levels) from the patient at home to health care providers has already been initiated and we foresee future progress in diagnostic and treatment software, not least in the psychosocial area in which U-CARE has a leading role.

Medical technology

Medical technology ranges from sensor technology, medical imaging and life support systems, to apps and 'non-invasive' surgical methods. Uppsala University and Uppsala University Hospital are combining their forces to build further on earlier Swedish innovations that have resulted in breakthroughs such as the pacemaker, the Gamma Knife and the artificial kidney. Medical technology also has an important role to play in raising the skills level of care staff and the awareness of patients, with the overall objective of achieving health benefits for the individual and society.

Migration, integration and racism

Discrimination and racism deny fundamental human dignity and ultimately pose a threat to society in its entirety. Integration is obstructed by excluding structures. Wars and refugee disasters risk leading to further polarisation. Uppsala University has a broad commitment in this area, building further on established strengths.

Precision medicine

The term 'precision medicine' refers to disease prevention and treatment based on each individual's – or group's – prognosis and response to treatment. The research area is based on a combination of knowledge about the human genome with new technology for molecular-medical diagnostics and methods that allow information to be extracted from very large quantities of data.

Mental health

With the aim of identifying social and biological causes of mental ill-health in a long-term perspective, Uppsala University and Uppsala University Hospital have together created a structure according to which all young adults assessed in psychiatric services are invited to take part in a longitudinal project. In this project, a basic clinical investigation is combined with a comprehensive assessment of physical health, personality traits and life events. The central plank of the project is a knowledge platform encompassing everything from epidemiological resources to a psychiatric biobank.

New smart materials

Uppsala University has long enjoyed well-developed cooperation with Swedish basic industries in the materials area. A coordinated effort is now needed in this area to increase innovation capacity, develop the value chain and protect Sweden's internationally prominent position. Uppsala University intends to move forward on an integrated research initiative – SciMaterial – emphasising the systemic perspective throughout the entire chain from natural resources/processes to recycled material.