SWEDISH FOUNDATION FOR STRATEGIC RESEARCH

Research Strategy 2012 – 2017

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Introduction

According to its statutes, the purpose of the Foundation is to support research and postgraduate studies in science, engineering and medicine in order to strengthen research environments of the highest scientific quality in an international perspective for the purpose of strengthening Sweden's future competitiveness.

The Foundation supports research of great importance for the development of Swedish industry and society, both in areas where Sweden is among the leading nations in the world today and in areas where Sweden has the potential to become a leader, in order to take advantage of the in-depth knowledge, expertise and structure that exists and can be created in our country.

The interpretation of the key words *strategic research* and *competitiveness* is decisive for how the Foundation carries out its mission. The Foundation has defined *strategic research* as research that will be of benefit to Sweden. Benefit can be assessed based on one or more of the following aspects:

- research whose results can serve as a basis for the development of existing or new enterprises;
- broadened and improved postgraduate programmes that produce scientists who are attractive for employment primarily in the business and public sectors, but also in academia;
- the ability of internationally high-class research environments to attract uniquely qualified scientists and international investments to Sweden;
- research that serves as a focus for international cooperation, whereby knowledge of interest to Swedish industry can be acquired.

All of this also contributes to more job opportunities, better working conditions and better health, as well as to a more sustainable society.

Competitiveness is evaluated on the basis of how well Swedish research and Swedish research results stand up to international comparison. The goal is that Swedish industry and Swedish society should

be strengthened, that Swedish positions should be advanced in terms of growth and sustainable development as well as vital human measures such as quality of life, and that the contribution of Swedish researchers to global research should grow in importance and scope.

2. Focus of activities

Thanks to its organizational form and independence, the Foundation enjoys unique freedom to act without regard to short-sighted and constraining considerations. The Foundation does not assume long-term funding responsibility for individual research areas; rather, its commitments are time-limited and its priorities shift between different areas and organizational forms based on current assessments of needs and opportunities. This means that resources are not distributed evenly in time between different research groups, scientific fields, social sectors, branches of industry, universities or institutes. The Foundation strives to focus its efforts and resources on areas where it can serve as a catalyst in creating added value by supporting creativity and innovative thinking in research and

postgraduate education within its sphere of activity in Sweden. The resources are targeted within selected focus areas, both at strong research environments and individual researchers.

A standard that must be met by all research programmes funded by the Foundation is scientific excellence. To prove that this standard is met, the results must undergo peer review, which normally requires publication in international scientific journals. The size of the grants is determined by how many researchers and research groups there are within the relevant areas covered by the call for proposals. Another prerequisite is that Swedish research must be strong in this/these area(s), or that it is important that Swedish research should become strong in them.

Besides being of the highest scientific quality in an international perspective, the funded research must have the potential of yielding additional knowledge and expertise that can be expected to ultimately be applicable within knowledge-intensive and high-tech branches of industry or social sectors in Sweden. Applications for research grants shall describe how the research results can eventually be put to use, for example in the form of technology transfer, demonstrators (new functional or technical concepts) or intellectual property rights. The Foundation does not support commercialization processes per se; however, 3% of each research grant can be used by the grantees for proof-of-principle research, advice and patent applications (Swedish and PCT).

The Foundation furthermore wishes to strongly encourage linkages between research areas that have not previously collaborated for the purpose of stimulating transboundary research.

The time frame for individual initiatives normally encompasses a grant period of 3-6 years (except for small programmes and ad hoc initiatives). A condition for funding of more long-term initiatives is that the potential exists for continuation and development of the programme with another funding body, for example if the programme fits into the long-term plans of the concerned university/institute, or if it can bring a new field to competitiveness with other funding bodies or be taken over by the relevant industry.

3. The financial framework

In contrast to most other major public research funding bodies, the Foundation is not dependent on annual appropriations. The Governing Board determines the budget for new commitments over time and is able to draw on the capital, not just the return. The Foundation's freedom to decide on the grant volume makes it possible to adjust the level of the grant to the prevailing situation in Swedish society and in the Swedish research and educational system.

Based on current and projected capital growth and on the need for research viewed in relation to demands on long-term stability in the Foundation's funding, the Foundation judges that the annual grant volume should be at a level of about SEK 600 million in real terms. The Foundation thereby expects to continue to be an important actor in the Swedish research funding system until 2030.

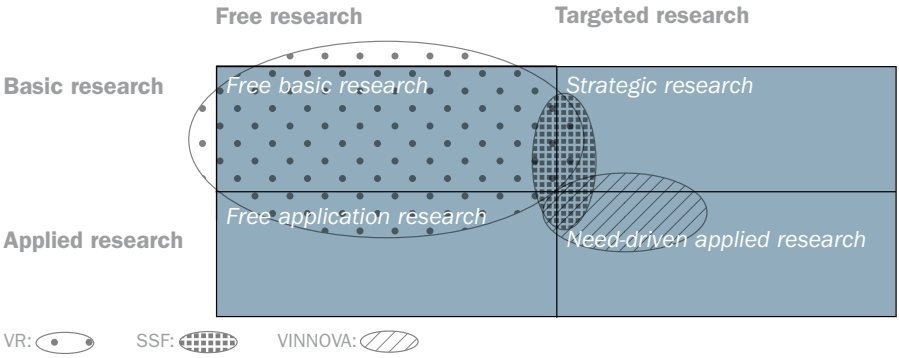
4. SSF's role in relation to other research funding bodies

According to its statutes, the Foundation shall support "both pure basic research and

applied research, as well as research that bridges the gap between these extremes". This means that the Foundation's sphere of activity overlaps those of both the Swedish Research Council (VR) and Vinnova. A schematic illustration of this can be plotted in a four-field diagram with degree of control on the x-axis (free vs. targeted research) and proximity to practical problems on the y-axis (basic vs. applied research). In such a diagram, the Swedish Research Council is more at home in the upper left-hand field "Free basic research", Vinnova in the lower right-hand field "Need-driven applied research" and SSF in the upper right-hand field "Strategic research", with overlap in relation to the roles of the other two authorities. See the illustration below.

applied R&D. However, joint funding of programmes by the Foundation and other funding bodies should only be considered in cases where such collaboration entails a considerable advantage due to the specific complementary expertise of another funding body. Furthermore, the Foundation is always looking for new forms of research funding that are important for Sweden's development, but which other funding bodies cannot always offer, in order to complement these other funding bodies for the purpose of meeting strategic needs.

Contacts with the Foundation's clients in the private and public sectors are also of crucial importance for the Foundation. The Foundation's evaluation panels always include business and other societal representatives.



The Foundation is prepared to contribute to and develop the cooperation that exists today between different research funding bodies. In particular, the Foundation regards it as advantageous if funding bodies with differing responsibilities can shift responsibility for certain programmes between themselves as they develop from basic research towards

5. Types of grants and main areas

The Foundation will primarily use the following types of grants: **Synergy Grants**, previously known as Framework grants, the individual grants **Future Research Leaders**, the **Ingvar Carlsson Award**, and **Strategic Mobility**. Synergy Grants support research carried out by 2 to 4 collaborating scientists

with complementary competencies to solve an import scientific problem. One of these scientists should be main applicant and the other co-applicants.

Micro Grants can be considered as a tool for the Governing Board, but only on its own initiative. Similarly, **"Wild Cards"** can be used in connection with joint international projects, for example. Such grants should target individuals, not groups of researchers.

Main areas should be selected on the basis of "need" and be targeted at a given discipline. At the same time, interesting "cross-connections" between disciplines must be taken into account. The main areas are very broad, which means that the Foundation has to focus more on the subareas. These subareas will be designated in scientific terms. The following main areas will be prioritized during the coming five-year period:

- **Life Sciences**
- **Life Science Technology**
- **Materials Science and Technology**
- **Information, Communication and Systems Technology**
- **Data-X and Computational Sciences and Applied Mathematics**

Furthermore, *ad hoc* initiatives will be undertaken when the Governing Board sees a need. Special *ad hoc* initiatives that will be undertaken are:

- **Swedish Infrastructure:** Development and utilization of existing or new infrastructure.
- **Special initiative to make use of neglected competence:** The current shortage of research funding in many European countries has created an opportunity to recruit young senior researchers (post-postdocs) to Sweden.
- **Special initiative aimed at young female researchers,** linked to a leadership programme.

Following are short descriptions of the above main areas and the subareas that may be included in them.

5.1 Life Sciences

The area includes research in clinical, preclinical medicine and veterinary medicine, as well as research on infections in trees and plants. It also includes research on biological production systems. Examples are plant biotechnology, forest biotechnology, synthetic biology and cultivation of e.g. algae for energy purposes. The area is divided into:

5.1.1 *Disease mechanisms*

– An understanding of the pathological course of diseases affecting man, domestic animals, plants and trees is essential.

Examples of subareas:

- **Infection biology:** Molecular mechanisms in the interplay between microorganisms/parasites and their hosts; prophylaxis; diagnostics; modes of treatment; zoonosis; emerging viruses; antibiotic resistance.
- **Development of biomarkers:** e.g. for diagnosis and prognostic monitoring of treatment
- **"Personalized medicine":** Diagnostic markers with higher resolution are being developed, providing possibilities for extensive studies of the total genome of individuals and permitting individually adapted medication in the future.

- **Rare diseases:** Diseases with a genetic background affecting fewer than 100 people per million (Swedish definition) or fewer than 500 people per million (EU definition).
- **Comparative studies of humans and domestic animals** aimed at e.g. learning more about lifestyle-related disease.
- **Epigenetic mechanisms, gene expression and phenotypic changes in health and disease.**
- **Translational research** in the areas of cardiovascular diseases, cancer, autoimmune diseases and kidney diseases.
- **Matrix biology:** Many important physiological and pathological phenomena such as angiogenesis, metastasis of tumor cells and infections are localized in loose connective tissue.

5.1.2 ***Biological production systems***

Examples of subareas:

- **Plant biotechnology:** Transgenic techniques are being used to develop resistance to biotic and abiotic stress or for the production of pharmaceuticals and defined lipid or starch qualities of high commercial interest.
- **Forest biotechnology:** Transgenic techniques are being used to achieve resistance to biotic or abiotic stress, to develop defined structural/chemical changes in cellulose, hemicellulose or lignin for production of polymers, viscose etc.
- **Synthetic biology:** Enclosed production in transgenic bacteria, fungi or microalgae of low molecular weight compounds of high commercial interest.
- **Open cultivation of algae** for e.g. energy purposes.

5.2 Life Science Technologies

Life Science Technologies is a main area, but it is also treated under other relevant main areas, such as "Materials for health and hygiene" under "Materials Science & Technology". To be successful, research in many of its subareas has to be carried out in close collaboration between scientists from the life sciences, the engineering sciences and the natural sciences.

Subareas might include:

- **Bioimaging:** Techniques that permit observations of life processes from molecular interactions to complex functions at the whole-body or organism level.
- **Regenerative Medicine:** Isolation or production of therapeutically relevant stem cells, differentiation of the stem cells into specific cell types; production of a suitable matrix to allow a functional artificial tissue or organ to form.
- **Biosensors:** External, free-standing devices for measurement of different parameters in e.g. blood samples; implantable or wearable biosensors for detecting clinically important factors connected online to medical care units.
- **Biomaterials:** Biocompatible materials used for implants in human bodies to replace e.g. hip joints; materials used for tissue regeneration or in implanted biosensors; materials for use in dialysis machines, heart-lung machines etc.
- **Systems Biology:** A relatively new research field focusing on a systematic study of complex interplays in biological systems, offering new perspectives where the whole is greater than the sum of its parts.

5.3 Materials Science and Technology

New materials technology is enabling for the development of important areas of application, such as energy conversion, ICT and medicine. Sweden is among the world leaders in industrial production of steel and advanced surface coatings. Surfaces, boundary layers and thin films for applications in environments with high temperature, high wear or pressure and high chemical or electromagnetic stress make high demands on resistant materials and are examples of areas where Sweden is strong both industrially and academically.

Initiatives in the area of materials science will take two forms: targeting a specific application, and development of new material classes.

5.3.1 *Examples of areas of application*

- **Energy-related materials:** Batteries, light sources, combustion and high-temperature applications, fission/fusion/radiation environments, solar cells and solar heat, low-friction applications, power transmission, electrical insulation, power electronics, high voltage, thermoelectricity.
- **Cutting tools:** mostly hard surfaces, but also low-friction materials and self-lubricating materials. High-performance steels.
- **Health and hygiene:** Functional surfaces, biocompatible materials, antibacterial materials, bioactive materials, biosensors.
- **Construction and buildings:** Functional surfaces, for example ”self-cleaning surfaces” and solar filters, but also environmentally friendly paint and building integration of active components.
- **Extreme situations and environments:** resistance to friction, temperature, corrosion and chemicals. Advanced surface technology is vital in this subarea as well.
- **Packaging materials:** Lightweight materials, sustainable and recyclable materials, active packaging materials used e.g. for detecting whether the contents of the package are damaged or degraded, or materials with printed electronic circuitry for advanced logistics or presentation of dynamic information.
- **Research for product realisation:** Those countries that can convert research results into low- cost processes, with no loss of quality, are the ones who will profit industrially. Research programmes that take this into account at an early stage are more likely to achieve this.
- **Sustainable raw materials and recycling technology:** Sweden has an efficient mining industry and good recycling procedures for bulk metals. However, innovative processes are needed for extraction and separation of rare earth metals from slag, electronic scrap etc.

5.3.2 *Examples of material classes*

- **Surfaces, layers and thin films:** In many applications the surface affects the properties of the material far more than the bulk does. A typical example is in machining, where a thin layer of a hard material such as silicon carbide can prolong the life of a cutting tool several times over. Another example is electronics, where most basic components are manufactured by advanced thin film application techniques.
- **Fibres and composites:** By combining different structural constituents in a material, its area of application can be extended, for example carbon fibre

materials combine low weight with high stiffness and resistance.

- **Low-dimensional materials and nanomaterials:** Nanotechnology provides ways to create new materials from the smallest components. Molecules, atoms and even electrons and photons can be detected and manipulated. Basic research in this area can lead to entirely new paradigms for material systems and techniques.
- **Polymers:** Polymers are often used to create flexible materials that are useful in for example applications within medical diagnostics using wearable or integrated sensors. Polymer technology makes it possible to create new lightweight and biodegradable materials for medical applications or recyclable and environmentally friendly packaging materials.
- **Metals and alloys:** Metals are still the dominant materials in a large part of the Swedish industrial sector. Certain paradigms in, for example, the automotive industry are centred around metal and welding technology, a situation that is not likely to change quickly. However, the use of lightweight alloys could lead to greater energy efficiency for the end users. Alloys can also combine properties such as hardness and toughness.
- **Insulators:** Insulating materials are of great importance for Swedish power industry and its subcontractors. Cables able to withstand higher voltages than today are needed to transmit electrical power over long distances from future energy sources.
- **Magnetic materials:** There are strong academic groups in the field of magnetic material research in Sweden. Research in this area could yield, for example, new sensors and more efficient electrical motors.

5.4 Information, Communication and Systems Technology

Society is becoming increasingly dependent on high-performing and well-functioning communications networks, not only for pure communications applications, but also as carriers of critical information for various purposes in electric power distribution (smart electricity networks), transport, health and the like. Nearly all advanced industrial products today contain systems that can be described as software-intensive. They create a platform for the ICT (Information and Communication Technology) on which we are becoming increasingly dependent. This imposes numerous demands on the properties of the infrastructure. Various requirements on design, analysis, availability, security, integrity and reliability must all be satisfied – often in real time.

Subareas might include:

- **Systems architecture and systems technology:** "Systems of Systems" – techniques, methods and tools for creating systems combining hardware and software components.
- **Software technology:** Development methods, programming languages and tools to support them that may be used in the ever-evolving development of software.
- **Software systems:** Computer programs, procedures and rules for the operation of a computer system and that can be stored in a computer's memory.
- **Networks and radio:** Networks of computers and sensors, often using

radio waves to transfer information, are ubiquitous in modern society.

- **Embedded and autonomous systems:** Embedded systems are computer systems integrated into other products such as cars or mobile phones. Autonomous systems are embedded systems that can act independently, such as a robot or an unmanned vehicle.
- **Electronics and photonics:** These are the hardware technologies that underlie the information technology revolution, where electrons and photons, respectively, are used for information handling and communications.
- **Robotics:** The design, construction, operation and application of robots – in some cases autonomous embedded systems capable of humanoid tasks such as interacting with their surroundings and with humans.

5.5 Data-X and Computational Sciences and Technologies and Applied Mathematics

This field is divided into **Data-X on the one hand and Computational Sciences** & **Technologies** and **Applied Mathematics on the other**, where the main focus of the first area is within Information Technology and the other within Mathematics. Calls for proposals may address both of these areas to guarantee that applications that overlap both areas are considered.

5.5.1 *Subareas within Data-X might include:*

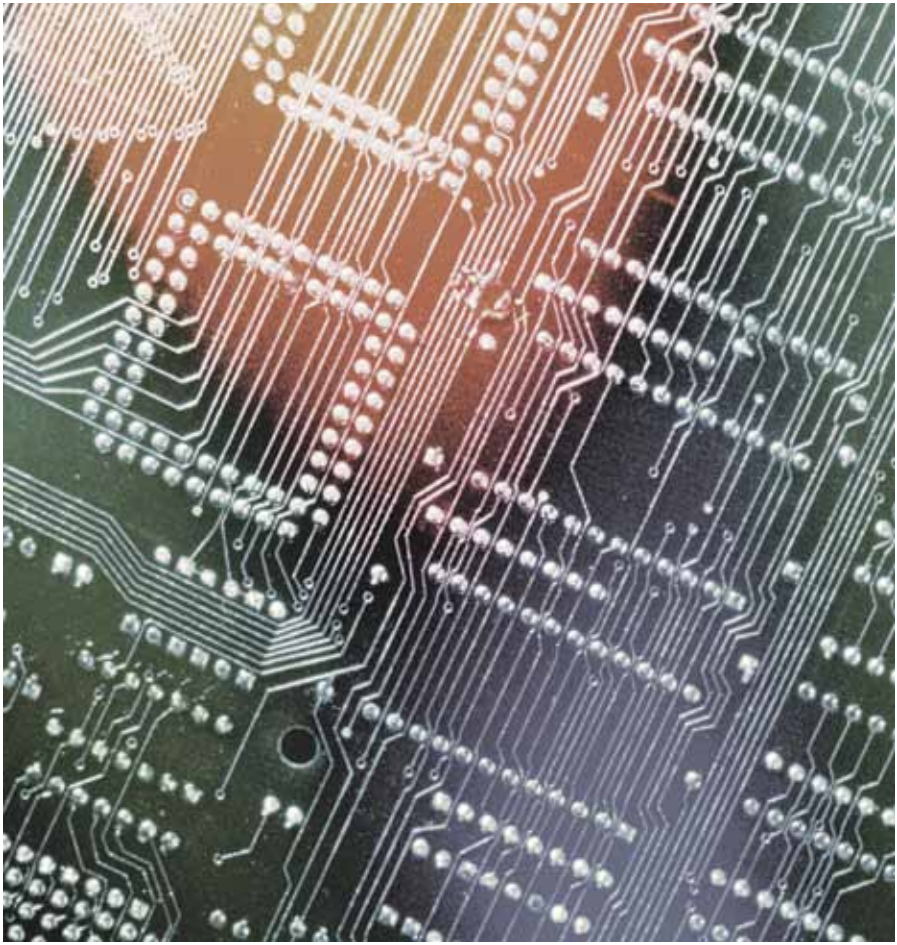
- **Visualisation:** Techniques for transforming data sets into representations that can be interpreted by the human eye.
- **Database systems:** Collections of data streams organized by a computer system.
- **Information systems:** Collections of hardware, software, people and procedures, including development and implementation methodologies that aim to produce quality information.
- **Data mining:** Techniques for discovering new patterns in large datasets.
- **Streaming data:** Development of database systems for handling very large and constantly changing datasets and methods for the analysis of such data.
- **Bioinformatics:** A multidisciplinary research area where algorithms for the analysis of biological and medical data are developed. Areas of application include structuring and storage of large amounts of data, visualization of data such as protein structures, phylogenetic relationships, genomics, modeling of evolutionary and cell biology data, analyses of DNA and protein sequences etc.

5.5.2 *Computational Sciences and Technology and Applied Mathematics may include the following subareas:*

- **Tools for high-performance computing:** For all areas of application.
- **Simulation and modeling:** Modeling refers to the construction of mathematical representations describing some "system". Simulation employs such (computer) models to study the system under specified conditions, for example in interaction with humans or other challenging surroundings.
- **Applied and engineering mathematics:** The mathematical fields in direct contact with technological or scientific applications, including analysis, mathematical statistics, stochastic processes, optimization and systems theory.

5.6 Swedish Infrastructure

The Science for Life Laboratory, the ESS (European Spallation Source) and Max IV are three facilities that can contribute to the Swedish adoption of technologies developed at similar facilities in other parts of the world as well as to new technology development in Sweden, for example of instruments. It is therefore important to encourage Swedish scientists to use these facilities. Support may be needed to stimulate interest in utilizing the facilities and to enhance competence in the research community, especially among young researchers and researchers in scientific fields where the techniques offered by the facilities have not previously been used. Another way to build future competence could be to support graduate schools in fields where the facilities will be utilized.



SWEDISH FOUNDATION FOR STRATEGIC RESEARCH

- Supports research in natural science, engineering and medicine for the purpose of strengthening Sweden's competiveness
- Finances a large number of research projects at universities, many in collaboration with industry
- Awards individual grants to particularly prominent researchers
- Supports important areas such as life sciences, information technology, materials development, electronics and photonics, computational sciences and applied mathematics
- Has an annual payment volume of about SEK 600 million

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P.O Box 70483, SE-107 26 Stockholm Visiting adress: Kungsbron 1, G7
Phone: +46 8 505 816 00 Fax: +46 8 505 816 10 E-mail: found@stratresearch.se www.stratresearch.se