SWEDISH FOUNDATION for STRATEGIC RESEARCH

10-03-30

The Swedish Foundation for Strategic Research (SSF) announces research group grants for research on Electronics and Photonics systems

Five-year research group grants for research on Electronics and photonics systems within a framework of maximum SEK 160 million are announced. Priority is given to systems oriented research, but research on component technologies that enable new systems or applications may also be supported.

The announcement concerns a number of research group grants for strategic research. The grants are intended to finance front-line research of the highest international class and of strategic relevance for present and future industry. The SSF research group grants are intended to be within the interval SEK 4 – 7 million annually (including overhead) and to finance goal-oriented projects. Each application should have a main applicant who should co-ordinate the project envisaged. A main applicant may submit only one application in connection with this announcement. The grant period is five years, although the funding for the two last years will be dependent on a mid-term evaluation.

The significance of electronics and photonics

The electronics and photonics industry is of fundamental significance for today's IT-dependent society. The semiconductor, materials and equipment industry generates the basic conditions for the huge global electronics industry. On top of this, the fibre optics communication industry is growing in importance. Furthermore, the service sector greatly benefit from the systems that the electronic industry supply.

The small pieces of silicon that are the basic building-blocks in electronics systems have invaded and influenced our lives to a greater extent than we are aware of. Most people know that bits of silicon get cell phones, MP3 players, home cinema installations and computers to work. But electronics also steps in to prevent cars from colliding or car wheels from locking when one brakes hard. Electronics ensures that pacemakers adjust the wearer's heartbeat, and it can also continuously monitor your health and well-being. Electronics both prolongs and saves lives. Electronics also keeps Sweden's base industries going, paper, pulp and steel. Sensors and control systems adjust processes to maintain quality at its peak level, and ensure that production is cost-effective. In addition electronic devices help improve the environment and reduce the need for energy.

Electronics is an important enabling technology in the development of new, renewable energy sources.

The photonics industry lags the electronics industry in terms of maturity, but already photonics technology is indispensable in our everyday lives in the entire industrialised world. A striking example is the wide use of Internet, which would not be possible without fibre optics communication. Any CD or DVD player contains semiconductor lasers and other photonics.

The electronics and photonics industry is globally competitive and enjoys a very high add-on value. As a key factor in this competition, the assets of Swedish companies consist predominantly of the competence their employees represent. This competence exists in Sweden because our universities and colleges are producing good engineers and researchers, offering a powerful reason for the industry to develop in Sweden. It is therefore of paramount importance that Sweden conducts research in the field of electronics and photonics (ICT hardware) both to enable the country to stay globally competitive and to attract the creation and establishment of new firms here.

Investment and priorities

ICT hardware includes many areas of research. Not all these, however, are of the same importance for Sweden's competitiveness. It is therefore urgent when investing in research to give priority to areas that have good prospects of being exploited in Sweden.

Areas of high priority

One trend in electronics is global specialisation where much of the manufacture at component and apparatus level is concentrated predominantly in Asia. A clear example of this specialisation and consolidation is among producers of silicon circuits of ”mainstream” type (i.e. digital CMOS processes). In this connection we note that while the industry as a whole is growing, especially the electronics manufacturing has left this country and Swedish industry is moving more towards systems development. Research supporting electronic systems development should thus receive priority.
In other areas such as optoelectronics and high-frequency electronics, global specialisation has not yet gone so far and there is still great potential for innovation at materials, process and component levels. There is still competitive high-end manufacturing in Sweden of both photonics components and fibre optics systems. Therefore, in this area, investment in component- and materials-related research in Sweden is more warranted than investment in silicon-circuit technology.
The type of research that will receive priority in the framework of this programme is illustrated graphically below. There must be a clear vision of applications and of the fact that overall requirements at systems level should guide the direction of research into components, processes and materials.

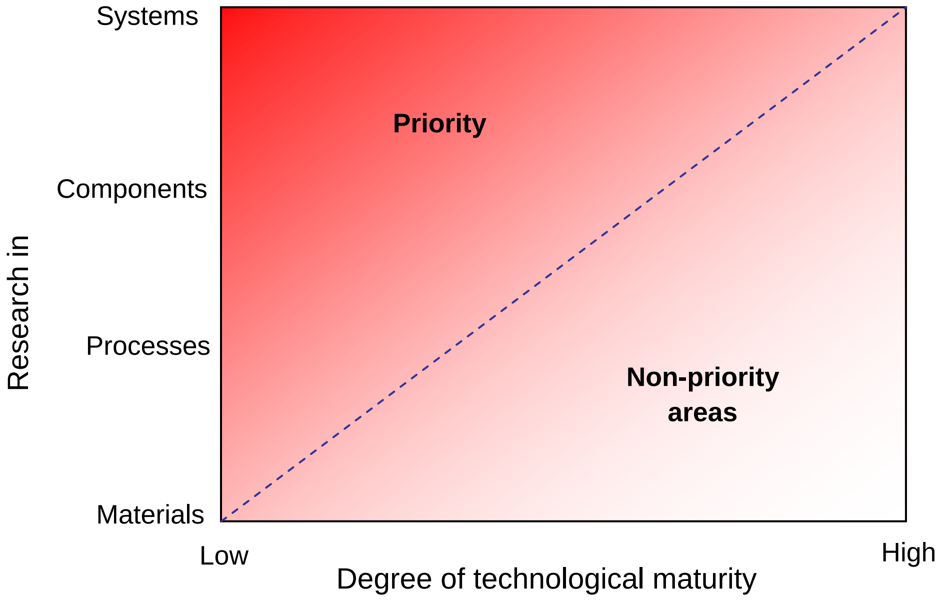

Figure 1. SSF Priority areas

Strategic relevance

The purpose of the Swedish Foundation for Strategic Research is to support research so as to strengthen Sweden's competitiveness in the future. In the research financiers' landscape, SSF positions itself between the Swedish Research Council and VINNOVA, as illustrated below. The practical definition of strategic relevance, to be used when ranking the applications, is that the research shall evince a clear vision of exploitation in Sweden over a time span of 5 – 15 years, after the project is finished. In addition, applications judged able to make a large contribution to Sweden's future competitiveness will receive higher priority than those judged to make a smaller contribution.

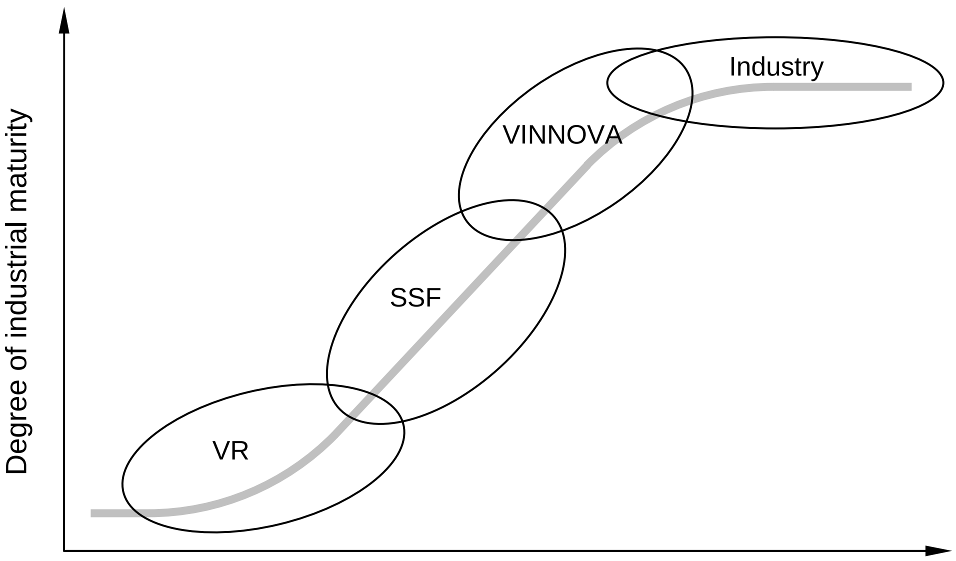

Figure 2. The role of Swedish research financers

Technology areas

Provided that the strategic conditions and priorities mentioned above are fulfilled, proposals within the following technology areas are of concern in this call.

Electronics and photonics systems

By electronics and photonics systems is here meant the hardware behind modern information and communications technology (ICT). The development of modern ICT is marked by increased functionality and capacity at a lower cost, volume and energy consumption. The overshadowing problem is increasing complexity and hence development costs. Important trends are increasing structuring of the industry (horizontal integration), increased programmability and continued exploitation of integrated-circuit development (Moore's law). Important application areas are information handling, communications (fixed, mobile, data, voice, video, infrastructure, terminals) and control and automation systems for production lines in process industry, vehicles, roads, the home, health and medical care etc.

Important research areas are systems architecture using modularisation, programmability and integrated communications strategy, hardware platforms as components of systems, circuit and system architecture for digital, analogue and mixed integrated circuits or modules, design methods and tools for all the levels mentioned, power optimisation, reliability, fault tolerance and test methods.

All the research areas demand good knowledge of fundamental limits, e.g. how much energy a certain operation requires if it is performed analogically, digitally or in software; in the electronic or the optical domain, and how energy costs develop with the development of integrated circuits.

Example of research problems may be related to mobile communication systems where increased demands for bandwidth and traffic capacity require better use of the radio spectrum. This is achieved partly through increasingly advanced algorithms for compensation of the limitations of the radio channel, use of multiple antennas etc; and also through expansion of the spectrum used. More advanced algorithms, in combination with increased bandwidths and increased traffic volumes, require extremely large computing capacity both in the base station and at the terminal. One enormous challenge is to manage specialized, and sufficiently flexible, computing requirements corresponding to that of 10 - 100 ordinary computers in a mobile telephone. Increasing the spectrum require handling of more frequency bands and higher frequencies. We see corresponding developments in broadband networks, modern radar, modern control systems etc.

Photonics technology lags behind electronics in terms of maturity, but already now photonics integrated circuits is a commercial reality. Several functions such as light generation, modulation, light amplification and monitoring can be achieved in fibre optics transmitters by a monolithically integrated single chip based on III-V semiconductor. Commercial integrated photonics has progressed farthest in applications where volumes are large and costs are low such as in signal splitters and transceivers for “fibre-to-the-home” (FTTH) deployment.

The complexity of modern integrated circuits, electronic or photonic, increases the demands on the methods used in their design. To meet the need for increased production capacity, design productivity must be increased more than tenfold during the next five years, while at the same time methods for testability, error tolerance and system simulation must be further developed. The trend towards integrating more and more functions will continue. This increases the need for structure in the circuits through the use of standard process modules (silicon or III-V IP), programmable blocks and standardised communication methods.

It is judged that process technology will obey Moore's law for the next ten years. The demands for design tools will be even greater and these are already falling behind process development. Choice of methodology in the design of these increasingly complex systems is a crucial factor for success.

This area of technology embraces everything from system function to implementation and verification. Co-operation with research in signal processing, embedded software and hardware is important. General computer technology is not included, but embedded computer systems, designed to meet challenging performance or power-efficiency demands, certainly are.

Certain types of software technology, e.g. code generation linked to programmable, innovative systems architecture and co-optimisation of hardware and software, may be included in electronics systems, but general methods of software development, real-time systems and compilers are not.

In fibre optics, communication and network technology has advanced rapidly enabling very high and commercially viable transmission capacity (e g FTTH). Fully-optical systems and better use of the electromagnetic spectrum through more efficient coding and new modulation formats are also important areas for research.

Electronic and photonic component technologies

Fibre optics communication is a precondition for the information society at global level and at local level. Transmitters, receivers and other components and sub-systems are being developed to have ever-increasing speeds, functionality and degrees of integration. New component technologies are of decisive importance for this development. Refined process technologies in III-V materials are essential for larger scale photonics integrated circuits. Low-dimensional structures enable improved performance and new functions. Hybrid or monolithic integration of dissimilar materials such as Si+III-V might be a path for more functional components. There are also other, non-conventional physical phenomena and associated materials that might be the basis for future generations of components.

For wireless communication and radar in the 1 - 100 GHz frequency band, fast components, circuits and antennae are required. Various techniques may be used including optical. Semiconductors with III-V material have developed appreciably during the past few years. It has become possible to design and manufacture monolithic circuits for frequencies up to some hundreds of GHz. Simultaneously with the development of GaAs technology, silicon-based integrated circuits have been pushed to higher and higher frequencies. Silicon technologies such as CMOS and bipolar transistors based on silicon and silicon-germanium may today potentially be used up to tens of GHz. Radio-frequency applications are important and so are optical communications and radar applications.

Components based on semiconductors with large bandgaps permit use at high temperatures, high operating voltages and high frequencies. Potential applications exist in power electronics, microwave and communications technology and high-temperature systems. Large bandgaps also permit emission at short wavelengths for energy-saving generation of light in the visible and ultraviolet areas with applications in e.g. lighting and in sensor systems. The most important materials are silicon carbide, III-nitrides (e.g. GaN) and diamond. Sweden is a world leader in this area.

Entirely new materials systems may be interesting for displays, sensors, memories etc. Examples of such materials systems are polymeric semiconductors, polymeric ion conductors, ferroelectric materials and ferromagnetic semiconductors, with applications such as programmable printed materials, displays, chemical sensors, mechanical sensors and ferroelectric or magnetic memories.

The technological area is limited to electronic and photonic component techniques. Applications may be sought in the communications industry and other sectors such as vehicles, process industry, medicine and medical care.

Application

A complete application must contain, among other data specified in the portal, a full description of the research programme and details of the relevant competence. It should contain a clear account focusing on the strategic significance of the research programme.

The application is submitted via the SSF portal at: http://apply.stratresearch.se. To get a complete view of all data required for submission it is necessary to consult the portal. Please log on to the portal in due time before the deadline.

Who may apply

The application must be submitted by a main applicant who should be an outstanding researcher associated with a Swedish university/college or research institute. If the main applicant is active at a research institute, at least one co-applicant must be working at a university. A presumptive project leader must be prepared to assume the scientific responsibility for the project during the whole period of the grant. The number of co-applicants must be in proportion to the amount applied for, preferably not exceeding three persons with relevant complementary competencies, from the same or different research groups. A maximum of 25% of the grant may be used for salary for the main applicant and/or the co-applicants (i.e the senior scientists), but only to cover up to a maximum of 25 % of the salary of each applicant. Each scientist can submit only one application as a main applicant in this call. Please note that principal investigators from ongoing five year SSF-projects from the electronics and photonics call 2007 (Rambidrag Elektronik 2007) may not apply as main applicants in this call.

Evaluation

Applications will be assessed by an evaluation committee. In a first selection the applications will be judged mainly on the strategic relevance and the scope (as described above). The continuing applications will be judged by international experts regarding their scientific quality. The result of the scientific assessment and the strategic value of the applications will then be weighed together by the evaluation committee in order to produce a final proposal on which the SSF board will make its decision.

The applications will be reviewed using the following criteria:

- Conformity to the scope as outlined above
- Scientific originality, strengths, weaknesses, interdisciplinarity, and feasibility of the research plan
- Qualification of the applicants, previous scientific accomplishments, international experience, and networks
- Strategic relevance to Swedish industry and/or society and importance of the proposed research

It is also important that the application presents a clear picture of the resources available and shows that the proposed constellation of research group will be effective.

Active commitment on the part of industry is positive. However, none of the collaborating industrial partners may be funded by the grant. SSF makes no formal demands regarding co-financing.

Timetable

- Last date for applications: **August 25, 2010, 14.00 hrs.**
- Decision by the SSF board: March, 2011 at the latest.

No additional material submitted after the deadline will be considered.

Note that the SSF follows the principle of public access to official records. For this reason, do not send material that may not become public at present, e.g. anything that could prevent possible patenting.

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