Smarter electronic systems for Sweden

Research and innovation agenda for smart electronic systems 2013

We stand on factual ground

This agenda was preceded by an extensive survey of the Swedish electronics industry's operators and their conditions for providing as true and accurate a picture of the current situation as possible:

- a market analysis conducted by an independent consultancy based on Swedish company statistics;
- a web survey sent to around 1,000 companies;
- in-depth interviews with persons in management positions from 42 selected companies.

Only companies with two or more employees were included in the survey. The results of their activities have functioned as a stable knowledge basis for the production of the agenda, and are downloadable in their full form at **www.smartareelektroniksystem.se**

As background material, VINNOVA's "Företag inom informations- och kommunikationsteknik i Sverige 2007-2011" [Companies in the information and communications technology sectors in Sweden 2007-2011], E Giertz et al., and previous reports have been used.

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SAMMANFATTNING PÅ SVENSKA

Detta dokument är en forsknings- och innovationsagenda för det svenska forsknings-, utvecklings- och produktionsområdet smarta elektroniksystem. Den gäller tiden fram till 2030 och är framtagen av Acreo Swedish ICT, Branschorganisationen Svensk Elektronik, Chalmers, KTH, LTU, PhotonicSweden och Swerea IVF vilka tillsammans äger rätten till innehållet som gärna får citeras om källan anges.

Elektronik är i högsta grad branschöverskridande och ingår i allt mer och utgör en allt större och viktigare andel i de produkter och tjänster som finns och utvecklas inom i olika branscher. Marknaden ökar. Elektronik kommer att efterfrågas allt mer i takt med att man måste finna nya effektiva lösningar för att möta de många globala utmaningar världen står inför, såsom krav på energibesparing, långsiktigt hållbar miljö och vård och omsorg om en växande och allt mer åldrad befolkning. Elektronik är en vital grundförutsättning i dessa lösningar.

Agendan har tagits fram inom ramen för VINNOVAs, Energimyndighetens och Formas utlysning Strategiska forsknings- och innovationsagendor.

Agendans förslag i korthet:

- **KOMPETENSCENTRA – GENERELLT**
  Vi föreslår att befintliga starka spetsteknologiområden som redan nu är att betrakta som starka kompetenscentra tar ansvar för och genomför aktiviteter mot industrin och att dessa samordnas.
  Vi föreslår också att staten genom VINNOVA, Energimyndigheten och Formas förnyar och utökar sina tidigare satsningar på kompetenscentra, arenor och demonstratoranläggningar/testbäddar/pilotlinor.
- **KOMPETENSCENTRA – PER SPETSTEKNOLOGI**
  Vi föreslår att samordningsaktiviteter för skapandet av kompetenscentra inom våra prioriterade delteknikområden anordnas av ett antal specificerade aktörer.
- **KOMPETENSCENTRA – EU-SYNK**
  Vi föreslår att våra föreslagna kompetenscentra genomför en samordning och systematisering av det svenska arbetet så att vi når en större kraft i samarbetet med aktörer inom EU.
- **ARENOR FÖR ERFARENHETSUTBYTE**
  Vi föreslår att Branschorganisationen Svensk Elektronik i samverkan med andra aktörer i ökad utsträckning arrangerar mötesplatser och kreativa arenor för utbyte av erfarenheter, kunskap och kompetens.
- **HÅLLBAR KOMPETENS I VÄRDEKEDJORNA**
  Vi föreslår att Branschorganisationen Svensk Elektronik i samverkan med andra aktörer i ökad utsträckning arrangerar workshops/seminarier för att stärka hållbar kompetens i värdekedjorna.
- **KUNSKAP TILL SME**
  Vi föreslår att staten finansierar program (typ minST, teknIQ och ESIS) för ett aktivt överförande av ny teknik till SME och för skapandet av en framåtriktad behovsbild utifrån marknaden.
- **SWEDISH ELECTRONIC SYSTEMS EU GRANTS OFFICES**
  Vi föreslår att de ovan föreslagna programmen ges ansvar att realisera externt finansierade ”Swedish electronic systems EU grants offices” med mål att öka SME:s deltagande i EU-projekt.
- **SME I EU-PROJEKT**
  Vi föreslår att aktörerna inom smarta elektroniksystem samordnar de aktiviteter som redan i dag bedrivs för att öka inslaget av strategisk efterfrågan och därmed förutsättningarna för SME. Initialt bör denna typ av kartläggningar genomföras med bas i seminarier/workshops.

■ **DEMONSTRATORANLÄGGNINGAR/TESTBÄDDAR/ PILOTLINOR**

Vi föreslår att Myfab, som är en av VR stödd infrastruktur och som under flera år byggt upp ett förhållningssätt till hur man delar denna typ av faciliteter, utgör modell för hur vi organiserar nyttjandet av testbäddar. Acreo Swedish ICT, Chalmers, UU och KTH leder nödvändig kunskapsöverföring.

Vi föreslår också att aktörerna bakom Myfab genomför en inventering av befintliga anläggningar i Sverige.

Vi föreslår dessutom att aktörerna bakom Myfab genomför en inventering av villkor för att aktörer, institut, företag och akademi ska kunna öppna upp sina demonstratoranläggningar/testbäddar/pilotlinor mot nystartade företag.

Vi föreslår utöver detta att staten undersöker möjligheterna till framtida finansiering av denna öppnare infrastruktur.

■ **KOMPETENSFÖRSÖRJNING**

Vi föreslår att organisationen Teknikcollege.se utvecklar och tillgängliggör konceptet teknikcollege med elektronikinriktning på en bredare front än i dag.

Vi föreslår också att industri och akademi etablerar samarbete för att besätta examensarbeten och skapa praktikplatser.

Vi föreslår dessutom att: industri och akademi tillsammans utvecklar mentorskap för högskolestudenter inom området smarta elektroniksystem.

■ **STÖDJANDE STRUKTUR**

Vi föreslår att staten skapar förutsättningar för en neutralitet mellan att vara anställd och att vara företagare när det gäller exempelvis arbetslöshetsersättning och sjukförmåner.

Vi föreslår också att samrådsgrupper skapas mellan de olika aktörerna i innovationssystemet, på central och regional nivå: Regeringen, Riksdagen, regionerna, övriga finansiärer, företagen i industrin, institut och akademi.

■ **INTERIMSTYRELSE**

Vi föreslår att en interimsstyrelse med representanter från de olika parterna inom området smarta elektroniksystem tillsätts för att bygga vidare på erfarenhetsutbytet från det genomförda agendaarbetet och koordinera de planerade aktiviteterna.

Vi föreslår också att denna interimstyrelse under 2014 ersätts med en permanent styrelse.

SUMMARY

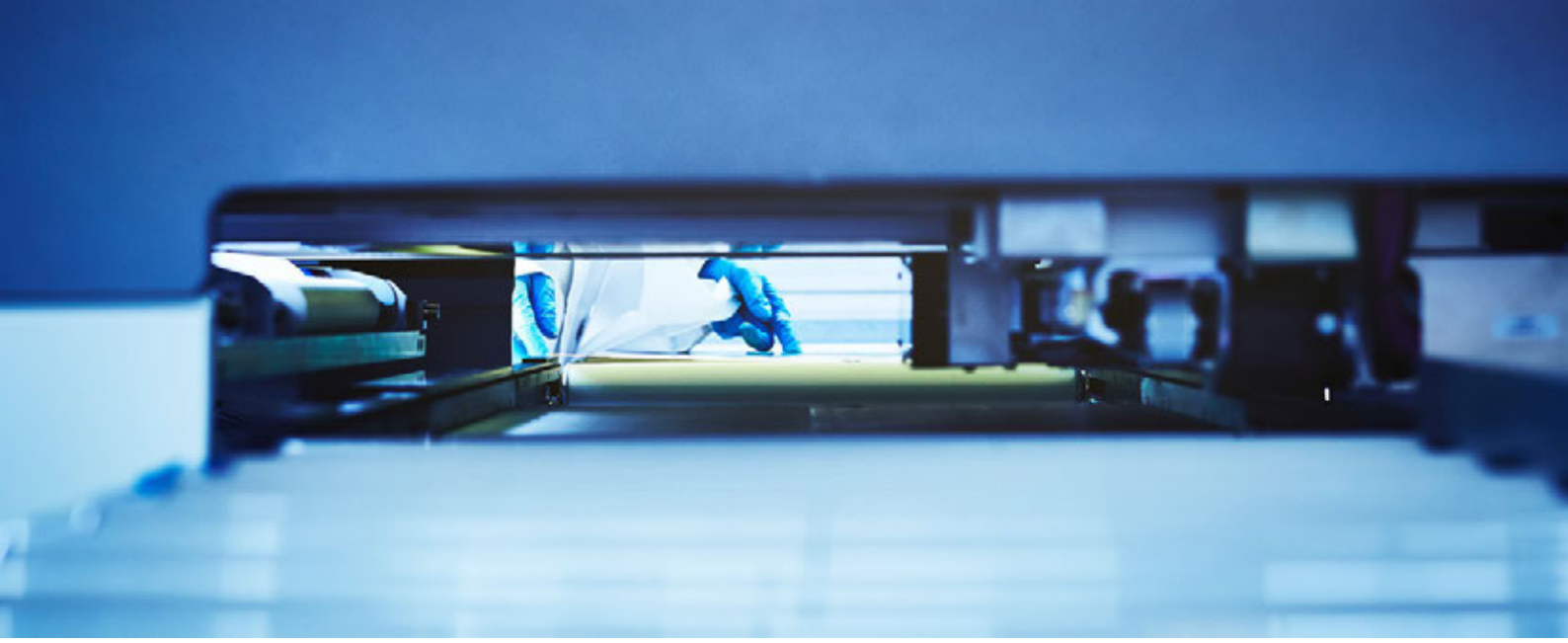
This document is a research and innovation agenda for Swedish research, development and production in the field of smart electronic systems. It applies up until 2030 and has been produced by Acreo Swedish ICT, the Swedish Electronics Trade Association, Chalmers University of Technology, KTH Royal Institute of Technology, LTU Luleå University of Technology, PhotonicSweden and Swerea IVF, who together own the rights to its contents, which may be quoted as long as the source is stated.

Electronics is introduced in more and more fields of applications and represents an increasingly important part of products and services available and developed within in a range of different industries. The market is growing rapidly. The demands for electronics will increase due to the expanding needs to find new and effective solutions to meet the many global challenges the world is facing concerning energy consumption, sustainable environment and care and concern for a growing and increasingly aged population. Electronics is a vital enabler for these solutions.

The agenda has been produced within the framework of the Strategic Research and Innovation Agendas issued by VINNOVA, the Swedish Energy Agency and Formas.

The proposals of the agenda in brief:

- **COMPETENCE CENTRES – IN GENERAL**
  We propose that the current strong and cutting-edge technology areas that are already viewed as strong competence centres take responsibility for and conduct activities geared towards industry, and that these should be coordinated.
  We also propose that the State, through VINNOVA, the Energy Agency and Formas, should renew and expand its previous investments in competence centres, arenas and demonstrator facilities/test beds/pilot lines.
- **COMPETENCE CENTRES – PER CUTTING-EDGE TECHNOLOGY**
  We propose that coordinating activities for the creation of competence centres within our prioritised sub-technology areas be organised by a number of specified operators.
- **COMPETENCE CENTRES – IN SYNC WITH THE EU**
  We propose that our proposed competence centres conduct a coordination and systematisation of Swedish efforts to strengthen our impact on the collaboration with operators within the EU.
- **ARENAS FOR THE EXCHANGE OF EXPERIENCES**
  We propose that the Swedish Electronics Trade Association, to an increasing degree in cooperation with other operators, organises meeting places and creative arenas for the exchange of experiences, knowledge and competence.
- **SUSTAINABLE COMPETENCE IN THE VALUE CHAINS**
  We propose that the Swedish Electronics Trade Association, to an increasing degree in cooperation with other operators, organises workshops/seminars in order to strengthen the sustainable competence in the value chains.
- **KNOWLEDGE TO SMES**
  We propose that the State finances programmes (like minST, teknIQ and ESIS) so that new technology can be actively passed on to SMEs, and so that a forward-looking image of market requirements can be created.
- **SWEDISH ELECTRONIC SYSTEMS EU GRANTS OFFICES**
  We propose that the programmes proposed above are used to implement the externally financed "Swedish electronic systems EU grants offices" – with the objective of increasing the participation of SMEs in EU projects.
- **SMES IN EU PROJECTS**
  We propose that the companies operating within smart electronic systems coordinate their current activities in order to improve strategic demand and, consequently, the operating conditions for SMEs. This type of mapping should initially be conducted via seminars/workshops.



■ **DEMONSTRATOR FACILITIES/TEST BEDS/PILOT LINES**

We propose that Myfab should be the model for how we organise the utilisation of test beds. Myfab is a VR-supported infrastructure that, over the course of several years, has developed a specific approach in respect of how these types of facilities should be operated. Acreo Swedish ICT, Chalmers, Uppsala University and KTH are leading the requisite transfer of knowledge.

We also propose that the operators behind Myfab conduct an inventory of existing facilities in Sweden.

We further propose that the operators behind Myfab conduct an inventory of whether suitable conditions exist that would allow operators, institutions, businesses and higher education institutions to open up their demonstrator facilities/test beds/pilot lines to companies.

In addition, we propose that the State investigate the possibilities for financing this more open infrastructure in the future.

■ **SKILLS PROVISION**

We propose that the organisation Teknikcollege.se should develop and make the concept of technology colleges with an electronic specialisation accessible on a broader front than is currently the case.

We also propose that industry and higher education institutions establish collaborations whereby trainee positions can be created and degree projects completed.

We further propose that industry and higher education institutions work together to develop a mentorship programme for higher education students within the field of smart electronic systems.

■ **SUPPORTING STRUCTURE**

We propose that the State creates conditions whereby, for example, employees and employers are entitled to equivalent unemployment compensation and healthcare benefits.

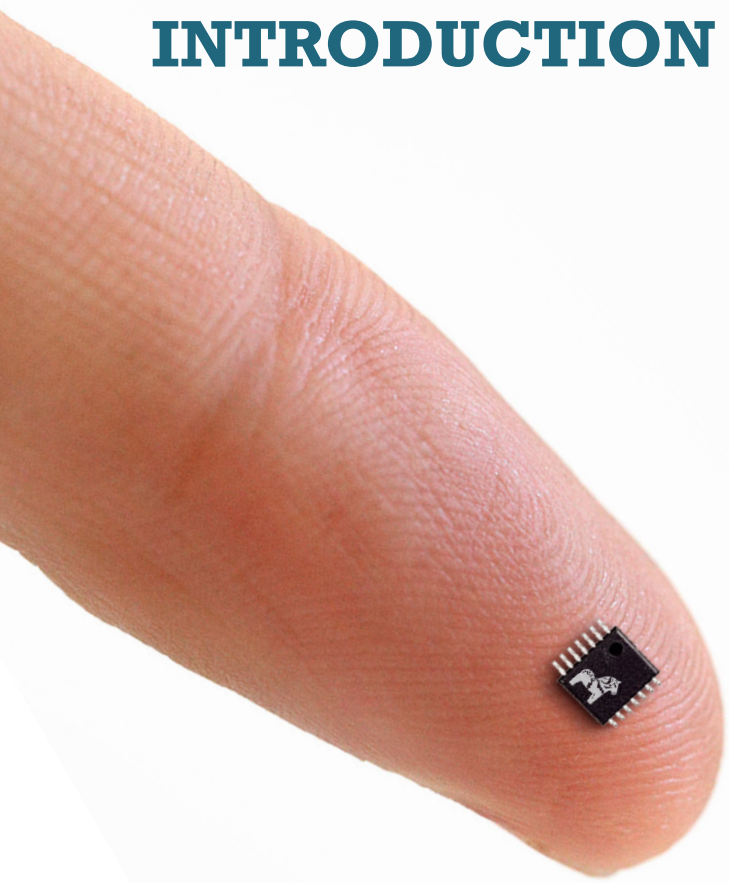
We also propose that consultation groups be established between the various operators involved with innovation systems, at a central and regional level: the Government, the Riksdag, the regions, other financiers, private industrial companies, institutions and higher education.

■ **INTERIM BOARD**

We propose that an Interim Board with representatives from the various parties within the field of smart electronic systems be appointed, in order to build on the exchange of experience resulting from the agenda work already conducted, and to coordinate the planned activities.

We also propose that this Interim Board be replaced by a permanent Board in 2014.

INTRODUCTION



Living in today's modern society means living in a close and intensive relationship with technology and electronics. Whilst most people today are very aware that high-tech integrated electronic systems are constantly present in our everyday lives, there are areas where we do not immediately see how much we depend on them. Many functions in society that we take for granted depend completely on electronic systems in order for them to work at all. These include the Internet, mobile phones or equipment for medical diagnoses and therapy. The demand for this technology is global and it is the answer to many global challenges. Electronic systems are a prerequisite of the society in which we live.

The EU and private industry are investing EUR 16 billion – what is Sweden investing?

Electronic components and systems will be central in future endeavours to achieve an economically and environmentally sustainable development on our planet. They will provide us with the tools to save energy and exploit renewable energy sources.

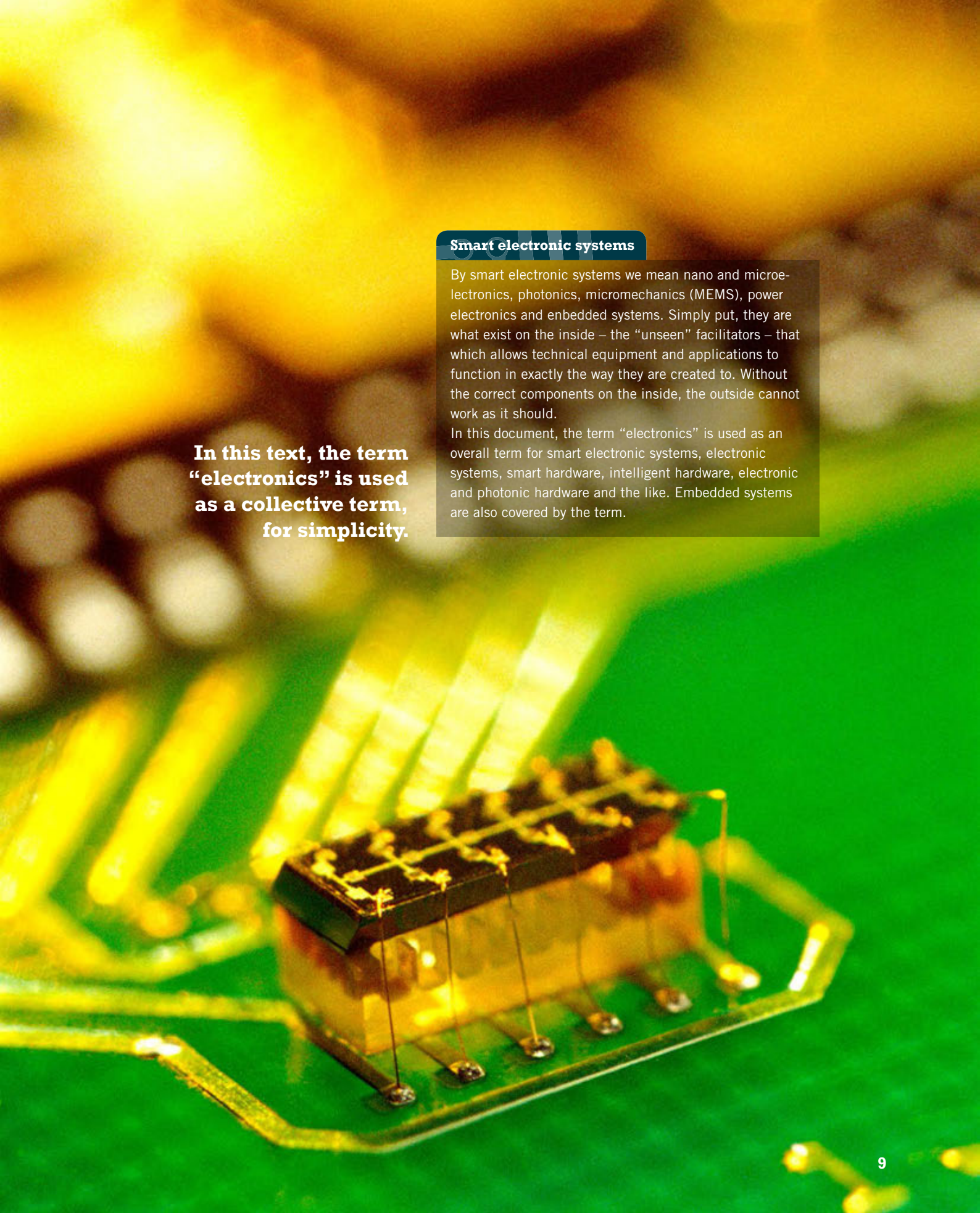
Electronic components and systems are highlighted in several of the EU's strategic future investments and, within the framework programme Horizon 2020, which has the vision of solving "major societal challenges", decisions have been made to invest a great deal of research resources in electronics, cyber physical systems, advanced calculations and smart manufacturing. These four areas are based on six key enabling technologies (KETs, see the fact box on page 16) and integrated software, which are considered necessary for future bolstering of the EU's capacity for industrial innovation, sustainable development and the creation of new products and services. The four areas are in focus in the majority of major investments from the European Commission under Horizon 2020.

Over and above this, the EU and 25 countries are, together with the industry, investing around five billion Euros in innovative electronics via the Electronics Components and Systems for European Leadership (ECSEL) programme.

Why Sweden?

Today, more and more Swedish and European companies see a strategic significance in proximity – not only in terms of understanding but also geographic proximity – between research, development and production. This is expressed very clearly in the German investment Industry 4.0 and the European technology platform ManuFuture, which raises the term "Re-industrialise Europe". Similar lines of thought can be found in the European electronic component and systems industry's powerful AENEAS and ARTEMIS organisations.

In order to realise the underlying ambitions, clear strategic research and innovation agendas for both electronic components and embedded systems have been developed. The current development clarifies that a close cooperation between the various parts of value chains between electronics, cyber physical systems, advanced calculations and smart manufacturing is the key to Europe's future competitiveness.



In this text, the term "electronics" is used as a collective term, for simplicity.

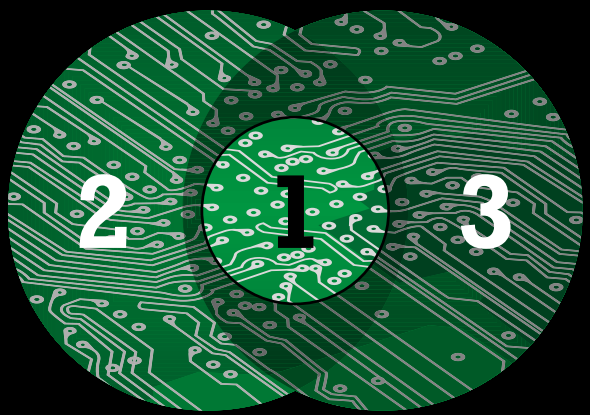
Smart electronic systems

By smart electronic systems we mean nano and microelectronics, photonics, micromechanics (MEMS), power electronics and enbedded systems. Simply put, they are what exist on the inside – the "unseen" facilitators – that which allows technical equipment and applications to function in exactly the way they are created to. Without the correct components on the inside, the outside cannot work as it should.

In this document, the term "electronics" is used as an overall term for smart electronic systems, electronic systems, smart hardware, intelligent hardware, electronic and photonic hardware and the like. Embedded systems are also covered by the term.

In a number of areas of application such as automation and telecom, Sweden and Swedish companies have a unique and leading position on the global market. These areas of application are subject to extremely tough international competition which is challenging the Swedish position. In order to protect and improve Sweden's position, strategic investments are required.

The electronics industry in Sweden



When we speak about the electronics industry, we are really referring to three industrial groups:

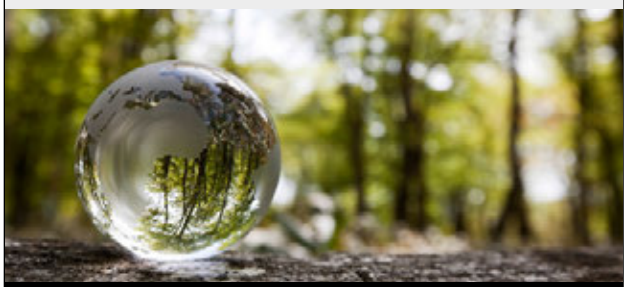
- Group 1: industry that manufactures electronic systems (around 3,600 companies).
- Group 2: industry that uses electronic systems in their products (around 7,700 companies).
- Group 3: Industry that is dependent on electronic systems in its manufacturing/business (around 14,900 companies).

Electronic systems are therefore a facilitator and a catalyst for growth, since they are used everywhere in industry and throughout society. This means that the electronics industry (group 1) functions as a lever or catalyst for all industrial sectors in Sweden. Innovations or new effective products in the field of electronic systems provide leverage throughout Swedish society.

There are over 11,000 electronics companies in Sweden (in groups 1 and 2), which together provide 300,000 jobs and have a turnover of more than SEK 1,000 billion. If we also include companies that are dependent on electronic systems for their manufacturing/business (group 3), the figure comes to SEK 2,500 billion in turnover and no less than 700,000 employees. The electronics industry (groups 1, 2 and 3) makes up 28 % of the total value added by Swedish industry. The electronics manufacturing industry alone (group 1) accounts for 11 % of the country's exports.

SWEDEN EXCELS: Environmental monitoring

Society has a fundamental need of detection and warning systems for dangers relating to microbial infection and oil/petroleum products. The online detection of bacteria and oil residues requires simple, robust sensors that are cheap to operate. A holistic solution currently under development within Swedish electronic systems R&D consists of two stages: first a warning that something has occurred, then identification of the type and scope of the danger. The solution and analysis can take in, store and process large quantities of data from many different sources. Providing access to data from these sources in an integrated manner makes it possible to offer many different types of functionality in the form of various services, such as SMS notification that a sensor is damaged, or automatic shutdown of a pump in the event of a fault.



The solution is generic and can be applied to many types of sensors, forms of analysis and service functionality. The project is intended to select and test a few existing technological solutions for sensory communication.

We cannot be strong in every area. We are strong in certain areas. More investment is needed there. There are areas in which we need to invest because there is currently a lack of expertise that is necessary for everything to work as a whole. This agenda draws attention to a number of important investments in the field of electronic systems that Sweden should make together with the electronics industry in order to continue to be competitive internationally. The agenda's proposals are also intended to increase the possibility of generating synergy effects with the European investments.

In a recent survey (see fact box), leading companies in smart electronic systems have highlighted the proximity to subcontractors and R&D partners as being crucial for the future. This was a factor that was prioritised ahead of skills development and skills provision, needs-based R&D and innovative capacity. Proximity is required to ensure competence and technological solutions are available in Sweden, and thereby reduce the need and risk of companies moving abroad.

In this document, we present in the margins a number of cases which illustrate how smart electronic systems can contribute to solutions to societal challenges whilst generating growth and export incomes. We identify where the innovation system needs stimulation and support and describe how an investment in a domestic electronics industry leads to a competitive industrial sector within Sweden's borders.

There is an interdependency between industry and academia: industry needs research findings to create innovation, and academia needs an outlet for its findings within national borders so that they can remain in Sweden and generate incomes and growth here.

With the right investments within carefully selected areas, research and business ideas can be transferred from the research lab to the market, coming to fruition in both innovations and thriving, profitable companies. In this document, we give our view of how these investments should look.

SWEDEN EXCELS: Industrial doors

Industrial doors need to meet requirements of low heat loss and a high level of security. A complete docking system comprises an industrial door, dock/loading bay and inflatable seals which enclose the vehicle. In this project, the industrial door has seen development from a mechanical opening to a complete logistics service. Following an extensive needs analysis, a system has been produced which, via sensors and network communication, integrates all functions such as controlling doors, loading bays and inflatable seals, monitoring via camera, burglar alarms, remote locking, identification/control and the like. In the same year that the system concept was launched, the SME received an order with a value corresponding to half its annual turnover. The company was sold after three years with a turnover of SEK 90 million.

The industrial door system facilitates greater efficiency, improved security, reduced heating costs and less damage, whilst making service and maintenance procedures more effective.

Insourcing/onshoring

For a long time, the world's industries have "outsourced" or "offshored" business not considered to be profitable within their own walls. This results in a low contract price but a long delivery time.

At present, and particularly in the USA, a reverse process is under way; "insourcing" or "onshoring" of the production from Asia to the homeland. There are also signs of this phenomenon in Sweden. It means a higher contract price but shorter delivery time. One reason is that the cost advantages gained from offshoring are often insufficient to cover the loss of flexibility. Suppliers in China are reported to offer a price that is 25-40 % lower than US suppliers, but this price difference is being gradually eaten up by:

- long delivery times, which result in greater storage costs;
- poor flexibility, which results in inadequate customer adaptation;
- bottlenecks in logistics and rising shipping costs;
- costs related to quality issues;
- product piracy and technology theft;
- poor control and transparency in the supplier chain;
- less confidence in the brand.

In a total cost model, the advantages can therefore amount to as little as 3 %, depending on the product.

A similar development in Europe will see the movement of a large amount of electronics manufacturing closer to Sweden. Demands are made in order to meet the needs of today and tomorrow, including:

- the rebuilding of manufacturing capacity;
- expert networks of subcontractors;
- links between design and production;
- better analyses of total costs.

VISION 2025

In 2025, Sweden will be a world-class industrial nation. In more or less all areas in which there is a dependency on advanced technology, Swedish companies (or companies that were originally Swedish) are at the very forefront of the global market.

One major reason for this is that we are world leaders in electronic systems. Electronic systems are multisectoral to the highest degree. They are found in an increasing number of contexts and constitute an ever greater and more important part of the products and services being developed in these industries. The market is thus growing.

Smart electronic systems will be in increasing demand in line with the need for new, effective solutions to meet the many global challenges the world currently faces, such as requirements for the development of renewable energy sources, more efficient energy production, the saving of energy, the long-term sustainability of the environment and the care of a growing and increasingly elderly population.

In 2025, Sweden as a country will be a very attractive prospect for companies of all sizes that are dependent on electronics, as here there is a geographical proximity to flourishing research and industry which, with its efficiency and niche expertise, provides solid anchoring for companies by offering an advantageous climate in which to operate.

The efficiency of electronic systems R&D is guaranteed by solid collaborative functions between all operators involved. The area of smart electronic systems is characterised by a high success rate, thanks to both a strong willingness among all the operators involved and good conditions for meeting one another's terms.

As a result of Swedish operators in the field of smart electronic systems focusing their niche expertise on areas where Sweden has the best competitive conditions, we

are world leaders in these areas. The link to the picture in terms of needs on the market side is well thought-out, clear and successful.

The area of smart electronic systems is supplied with competent personnel by an educational system that has strong ties with both research and the industry via relevant subjects, pronounced elements of "industrial reality" in undergraduate education and the potential for academic development.

Overall, the 2025 world map of electronics development is very different to that of today, and Sweden has secured pole position. The Swedish expression "to be on the train when it departs" fits, but is not fully adequate. By 2025, Sweden will not only have boarded the train, we will also have taken on the role of engine driver in selected areas and even identified areas of trackless terrain where new railways can be built.

In other words, the electronics industry has potential for considerable growth in both the short and long term. A competent and competitive electronics industry is a prerequisite for a successful and internationally competitive industry as a whole. Sweden has every reason and all of the conditions to secure its position as a global leader. But this position must be earned – continuously.

Horizon 2020

The EU framework programme Horizon 2020 emphasises seven societal challenges facing the EU and the rest of the world. A list of the seven challenges can be found at **www.vinnova.se/sv/EU-internationell-samverkan/Horisont-2020**

CHALLENGES

If Sweden and Swedish operators are to remain competitive in the field of smart electronic systems in the future, as described in the "vision" in the previous chapter, then there are three main challenges ahead. We will need to achieve better collaboration in value chains, create a clearer niche for the country and ensure a more secure provision of skills.

Challenge 1: Achieve better knowledge transfer and collaboration in the value chains

Companies operating in the field of smart electronic systems in Sweden cover everything from new ideas to products on the market, a journey which is also the very definition of innovation.

However, no individual operator can span the entire journey themselves. We are talking about value chains of interlinked operators (see the tree diagram on page 15). Some operators develop components, some in turn are integrated into the system by other operators. The systems then become parts of applications, which are then further developed by other operators (see the figure at the top of page 15). These groups of operators can be seen as links in a value chain, from the basic idea to the product on the market for the end customer – an innovation chain, which is constantly changing as both technologies and operators are renewed and replaced. Despite this, the chain must not be broken, if societal benefits are to be realised.

Each link of this chain involves an R&D process, from an idea to a product that must be taken care of by the next link. This means that even at a lower level of abstraction – in the respective parts of component, system and application – we must ensure that the flow from idea to result is uninterrupted and as effective as possible. This flow can be illustrated using the "technology readiness level" (TRL, see the diagram below).

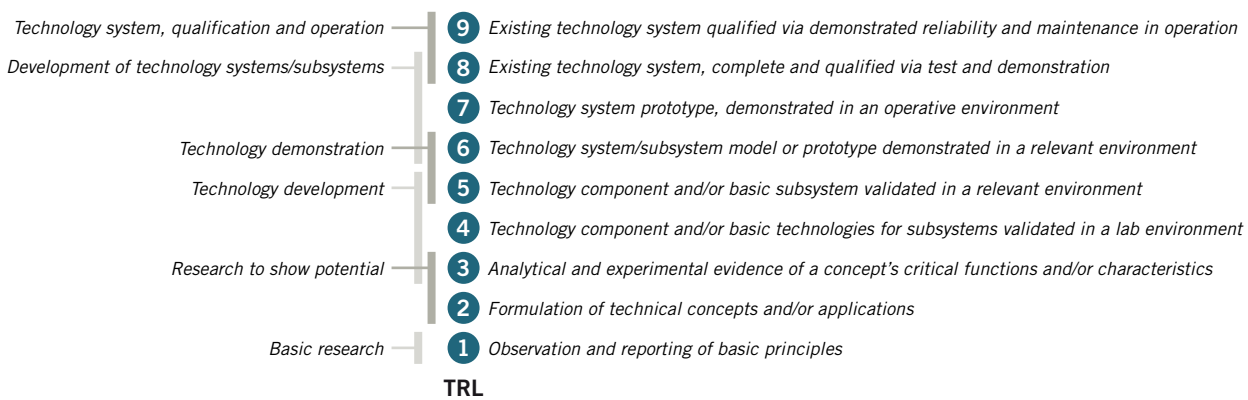


Figure 1: The technology readiness level (TRL) indicates how far an idea has come on its journey towards becoming a product on the market. The nine levels are consolidated in a TRL chain where technology is taken to a more concrete form, which means that we can speak of it as a (vertical) value chain.

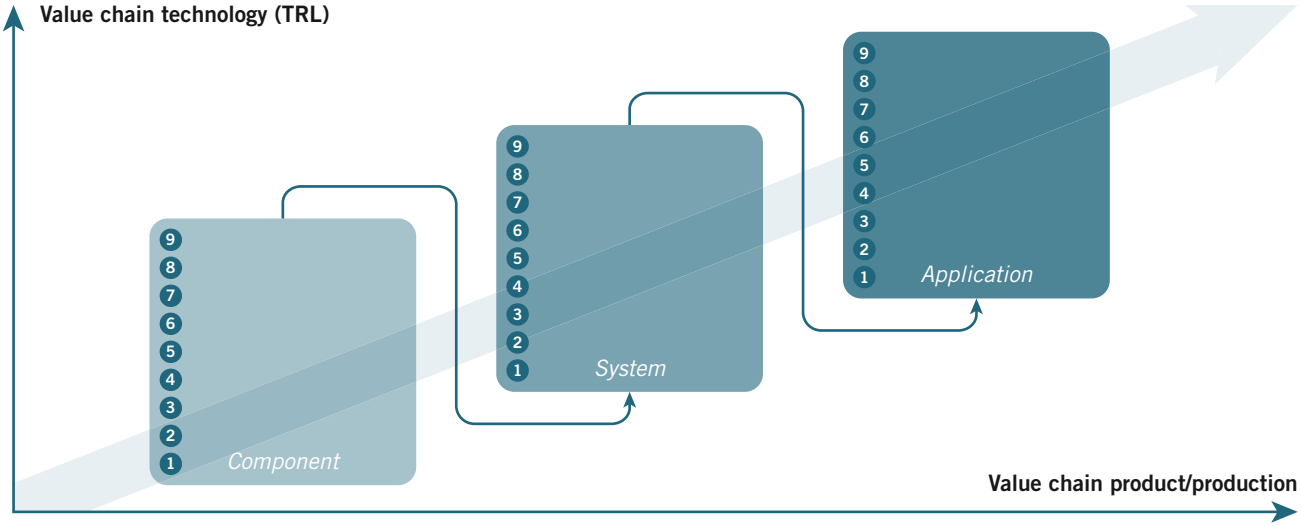


Figure 2: There is also a (horizontal) value chain in the form of components consolidated into systems, which are then baked into applications. Each stage in this chain contains its own TRL chain, where the market is defined as an outlet to the next stage of the chain. The resulting value chain from idea to product on the market, the innovation, thus becomes dependent on both of these value chains running efficiently and without interruption.

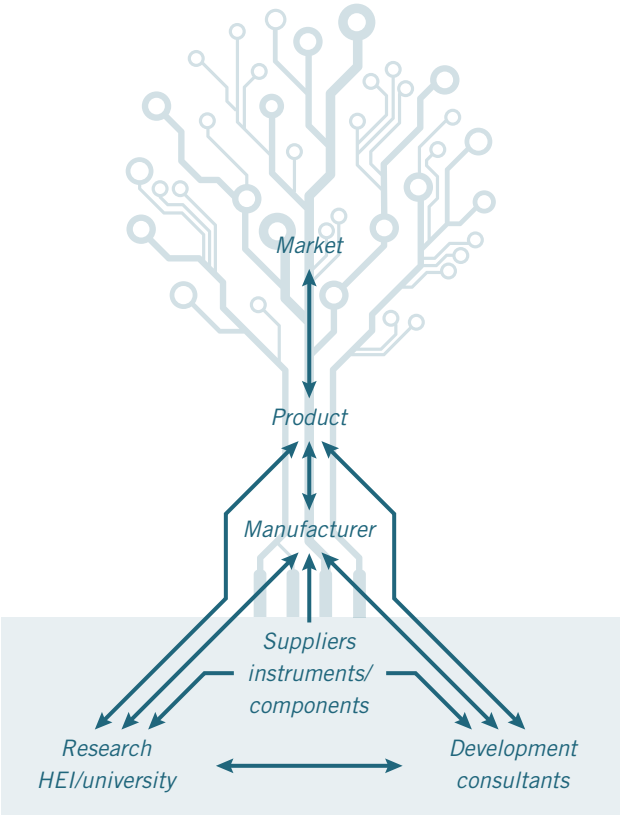


Figure 3: We can also represent a value chain with a tree that comprises the entire flow with all operators required from development and manufacturing all the way up to the final product for the customer.

The overall innovation process is therefore a collaboration between operators, each one acting in a more or less isolated sector. It is therefore obvious that the transfers between these operators must work effectively in order for the journey to be completed and for innovation to come to fruition. Each operator's understanding of what their individual role entails – and what all other roles entail – is of critical importance for the function of the innovation system.

Accordingly, it is of the utmost importance that every operator has both good procurement skills and capacity to formulate their own offer. One way to look at the operators' collaboration is to consider each operator as both customer and supplier at the same time. Customer to the party before them in the value chain, supplier to the party behind them. The transfer must be seen as a commercialisation. However, only after the application link does the market consist of end customers: the other links commercialise themselves to other R&D operators who take the technology to the next stage. The commercialisation must work regardless.

Challenge 2: Create a clearer niche for the country

The Swedish area of smart electronics systems needs a better niche, reinforcement in terms of expertise, and must be refined to a limited number of areas of strength within which Sweden and Swedish operators are considered the obvious choice as supplier.

As part of this, Sweden needs to concentrate its offerings within the technology area of electronic systems to a limited number of niche areas. The areas we propose are:

- micro/nanoelectronics
- printed electronics
- power electronics
- photonics
- antenna, microwave and terahertz systems
- sensors
- embedded systems
- assembly technology and reliability
- advanced production technology

These areas have been selected not least due to the fact that they work well in conjunction with the key enabling technologies developed by the EU (see fact box).

Apart from the direct link to the EU's list of technologies, the eight sub-areas have been chosen because they are currently or have the potential to become areas of strength in Sweden, and because they prepare us to have an optimal presence in the market areas that are important for Sweden and which, in our survey, have come across as the most dependent on our technology in the future:

- Automotive
- Medical technology/life science
- Military/security
- Telecom
- Energy
- Automation/production

Increased complexity of products, undermined competence and more partners in the value chain have meant that the reliability of the products is at risk. New types of components are designed in order to optimise func-

Key enabling technologies

The European Commission has produced a list of key enabling technologies (KETs) within which Europe must apply itself to basic research, innovation and cluster strategies in order to meet future societal challenges such as environmental considerations, and requirements for greater competitiveness in a knowledge economy.

- nanotechnology
- micro and nanoelectronics
- industrial biotechnology
- photonics
- advanced materials
- advanced production systems

How we assess the strategic needs of the most relevant market areas in terms of the proposed Swedish niche technologies. The assessment is based on our survey (see page 2) and proceeds from the markets' own assessments of current needs. The assessment is not static. We expect that it will change along with the function of many factors, not least external factors.

	Automotive	Medical technology/ life science	Military/ security	Telecom	Energy	Automation/ production
Micro/nanoelectronics	3	2	2	2	3	2
Printed electronics	2	3	1	3	2	2
Power electronics	3	2	2	2	3	3
Photonics	2	3	3	3	2	3
Antenna, microwave and terahertz systems	2	2	3	3	1	2
Sensors	3	3	3	2	3	3
Enbedded systems	3	3	3	2	3	3
Assembly technology and reliability	3	2	2	2	3	2
Advanced production technology	3	2	2	2	2	3

3 = very great need, 2 = great need, 1 = need, 0 = no need.

tionality, often at the expense of lifespan. For products with an expected long lifespan and/or tougher operative environment, this can be a major problem. Manufacturability and reliability are not a guaranteed result of adherence with applicable standards in the design and production processes. New standards for reliability programmes clearly point out the product owner as being responsible for ensuring reliability. This responsibility needs to be moved back from production to design, which requires a change of working method at the design stage.

Our list of proposed technologies for prioritisation is something of a mixed bag. Some items may be seen as clearly defined areas of technology, whilst others may be considered areas where the technology may be applied or even created There is no sense in trying to bring absolute clarity to how technologies are related to one another from this perspective; we can be satisfied with showing that are all highly motivated and are necessary if Sweden is to realise innovation.

In the table on the previous page, we show an assessment of the strategic needs for 2025 for select Swedish niche technologies within the most relevant market areas. Compare this with challenge 1 above, however: transfers to "the market" do not necessarily mean we are talking about an end customer relationship with potential benefits for society. A large proportion of the transfers are to other R&D operators who take the technology further into more integrated systems or applications. It is a value chain in which mechanisms for supply and demand must work, even in a changeable world where the supply and demand are constantly changing and being replaced.

The table shows that the proposed technologies are enabling and conducive to growth for a large number of market areas. We also see that a number of market areas have a common need of development of the niche technologies that we propose as prioritised for Swedish operators.

Challenge 3: Ensure a more secure provision of skills

Access to people with the right education and an interest in smart electronics systems must be secured in order to avoid recruitment problems in the future which present an obstacle to growth in the area and so that we can handle the competition.

The challenge consists of three underlying problems.

- First of all, we see all too few young people applying to technological study programmes, at all levels of education.
- Secondly, we see that the link between programme content and industrial needs is often weak. There is a lack of education in important areas.
- Thirdly, we see a problem in the difficulties experienced by foreign students when trying to remain in Sweden after completion of their studies.

OBJECTIVES

In order to clear the challenges in the previous chapter, we are establishing a number of objectives for 2020 and 2025 respectively.

GR

Overall objectives:
Sustainable growth in Sweden

As discussed in the introduction, the electronics industry is an enabling ground for around 80 % of Swedish industry. If Swedish industry as a whole is to grow and take on the global challenges for growth within the scope of environmental conditions, it will need an electronics industry which quantitatively and qualitatively matches this increase with the competence to meet future challenges.

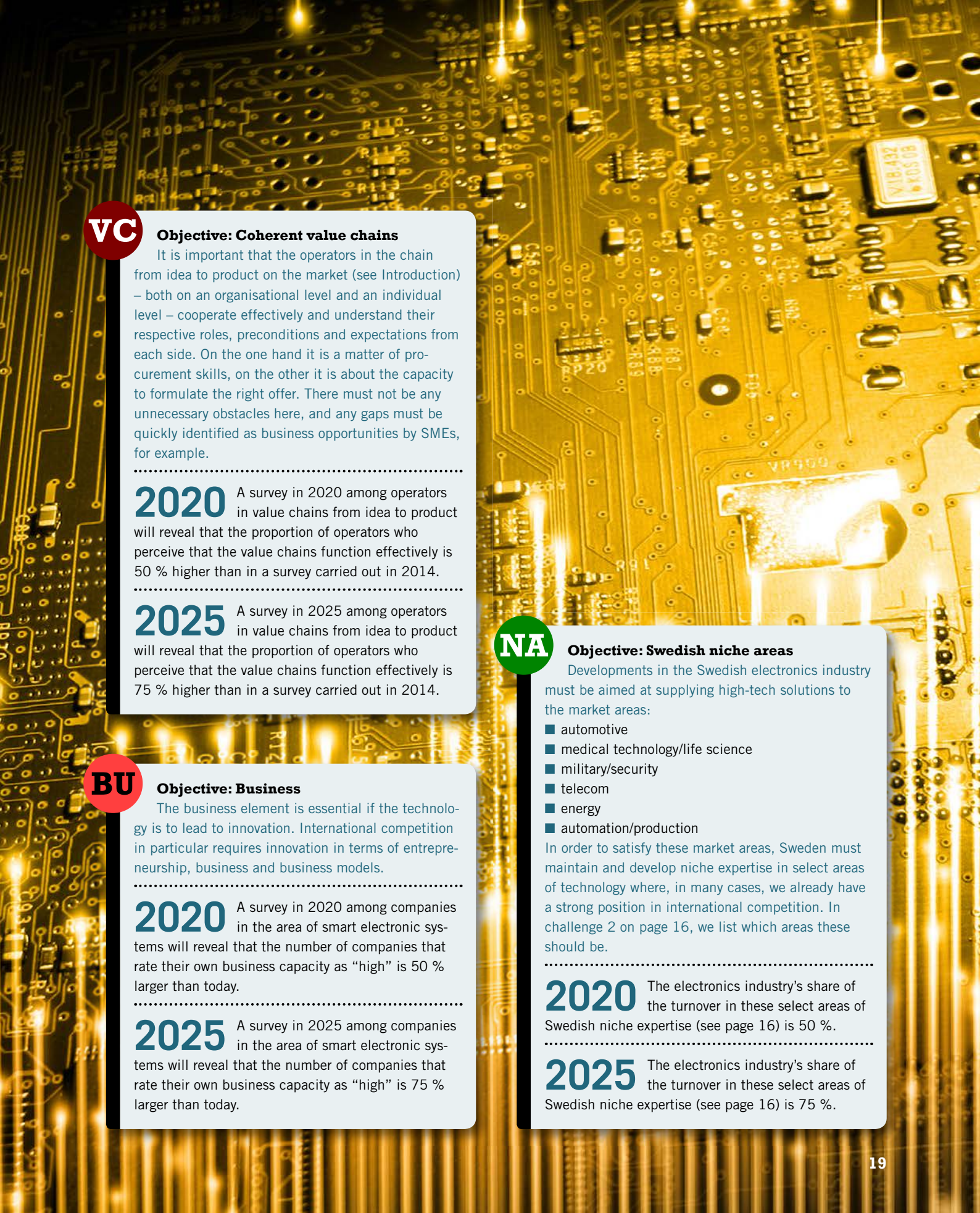
It is of the utmost importance for Sweden that the enabling technologies of the electronics industry are primarily Swedish, as other industry (groups 2 and 3) maintains that geographical proximity to the electronics industry (group 1) is crucial for the ongoing development of activities in Sweden, not least for SMEs and innovative start-up companies.

Furthermore, electronics is an export industry in itself, with export incomes, job opportunities and a competition-driven motivation to further increase the level of innovation.

We are therefore establishing the following overall objectives for the growth of the Swedish electronics industry:

2020 A survey in 2020 among companies that are dependent on electronic systems in products, manufacturing and operations will reveal that the number of companies that feel they can satisfy their need of electronic systems via Swedish suppliers is 50 % higher than today.

2025 A survey in 2025 among companies that are dependent on electronic systems in products, manufacturing and operations will reveal that the number of companies that feel they can satisfy their need of electronic systems via Swedish suppliers is 75 % higher than today.



VC

Objective: Coherent value chains

It is important that the operators in the chain from idea to product on the market (see Introduction) – both on an organisational level and an individual level – cooperate effectively and understand their respective roles, preconditions and expectations from each side. On the one hand it is a matter of procurement skills, on the other it is about the capacity to formulate the right offer. There must not be any unnecessary obstacles here, and any gaps must be quickly identified as business opportunities by SMEs, for example.

2020 A survey in 2020 among operators in value chains from idea to product will reveal that the proportion of operators who perceive that the value chains function effectively is 50 % higher than in a survey carried out in 2014.

2025 A survey in 2025 among operators in value chains from idea to product will reveal that the proportion of operators who perceive that the value chains function effectively is 75 % higher than in a survey carried out in 2014.

BU

Objective: Business

The business element is essential if the technology is to lead to innovation. International competition in particular requires innovation in terms of entrepreneurship, business and business models.

2020 A survey in 2020 among companies in the area of smart electronic systems will reveal that the number of companies that rate their own business capacity as “high” is 50 % larger than today.

2025 A survey in 2025 among companies in the area of smart electronic systems will reveal that the number of companies that rate their own business capacity as “high” is 75 % larger than today.

NA

Objective: Swedish niche areas

Developments in the Swedish electronics industry must be aimed at supplying high-tech solutions to the market areas:

- automotive
- medical technology/life science
- military/security
- telecom
- energy
- automation/production

In order to satisfy these market areas, Sweden must maintain and develop niche expertise in select areas of technology where, in many cases, we already have a strong position in international competition. In challenge 2 on page 16, we list which areas these should be.

2020 The electronics industry’s share of the turnover in these select areas of Swedish niche expertise (see page 16) is 50 %.

2025 The electronics industry’s share of the turnover in these select areas of Swedish niche expertise (see page 16) is 75 %.

YB

Objective: More young, competitive businesses

One special case resulting from the reasoning behind value chains is that many newly started companies are eliminated in the so-called "valley of death", which is the journey from having a business idea based on one or more verified research findings to establishing competitive and thriving production. It is relatively simple to generate financing for the demonstration of a concept on a lab-scale or at the prototype stage. To secure sustainable financing during the ongoing journey to production, however, is considerably more difficult. Even if this is a general problem, it must be managed on several levels.

2020 The number of young businesses (max. ten years) with more than ten employees is 25 % higher than today.

2025 The number of young businesses (max. ten years) with more than ten employees is 50 % higher than today.

DF

Objective: Access to demonstration facilities/test beds/pilot lines

Apart from the purely value chain-forming profits with access to facilities for demonstration facilities/test beds/pilot lines, these facilities may also mean greater efficiency and innovative capacity for companies in the form of synergy and collaboration effects. They can also mean life or death to SMEs that do not have their own facilities. The proportion of companies that utilise this infrastructure can and should therefore increase. At present, this resource is primarily used for academic research. Institutions operating out of laboratories should expand their crucial role of offering different types of lab-based services in order to facilitate access from businesses, e.g., by means of their personnel having greater participation in development projects where they assist with their specialist expertise.

2020 The degree of coverage of demonstration facilities/test beds/pilot lines will be 50 % higher than it is today.

2025 The degree of coverage of demonstration facilities/test beds/pilot lines will be 75 % higher than it is today.

Example: Myfab

Myfab is a network of three laboratories (cleanroom facilities): at KTH, Kista (Electrum Laboratory), Chalmers, Göteborg (MC2) and Uppsala University (Ångström Laboratory). The purpose of Myfab is to conduct R&D and small-scale production on a micro and nano-scale, as a cooperation between academia and institutions, and as an incubator for up-start companies. The three laboratories constitute more than 4,800 m^2 of cleanrooms with advanced processing and analysis equipment. There are currently more than 600 active users, from HEIs and industrial enterprises in Sweden and abroad. More than 130 research-intensive companies have used the laboratories over the last five years.
Myfab is also working to link up with similar facilities in other European and Nordic countries.

SP

Objective: Skills provision

The courses provided by universities and HEIs in the areas covered by the agenda are currently undergoing a crisis. The number of applicants and the number of places available do not correspond with the strategic needs of the area of smart electronic systems. There is also a lack of education in important areas.

2020 A survey in 2020 among companies in the area of smart electronic systems will reveal that the number of respondents who feel that they have access to the qualified personnel they need is 50 % higher than today.

2025 A survey in 2025 among companies in the area of smart electronic systems will reveal that the number of respondents who feel that they have access to the qualified personnel they need is 75 % higher than today.

EU

Objective: EU funding for Swedish R&D

Sweden is currently a major recipient of research funding from the EU. Sweden currently receives five per cent of the EU's research budget but accounts for only two per cent of the EU population. As the EU is expanding by adding new member states, and more operators in the area of research and development are applying for research funding from the EU, competition has increased.

The EU is investing a sum of EUR 16 billion in IKT. The Electronics Components and Systems for European Leadership (ECSEL) programme, which is one of the tools for supporting the six key enabling technologies that have been developed (see fact box, page 16), will receive around EUR 1.2 billion of this (a total of around five billion Euros via national and industrial co-financing). In FP7 and previous framework programmes, Sweden has been a net contributor to the EU and has thereby received less research funding in relation to what it has contributed. This ratio will improve.

2020 & 2025 Sweden maintains its share of EU research funding, with a greater share for SMEs.

SWEDEN EXCELS: Milk analysis

A prematurely born baby lives on breast milk, which can vary drastically in its nutritional content. An analysis of the milk has meant that it is possible to add an enriching preparation so that the content of protein, carbohydrates and fat is optimised for a specific child. A prize-winning product (Swedish Embedded Award 2012) developed by Swedish operators can provide analyses of breast milk, amongst other things. The instrument is the first portable IR instrument for milk analysis. It is small, fast and easily maintained, which means it is easy to use out in the field. The benefits for neonatal care are huge, not least in developing countries.

This analytical instrument for the content of milk has very positive effects for preterm care.

RECOMMENDED ACTIVITIES FOR SUSTAINABLE GROWTH IN SWEDEN

There are a number of tangible activities that need to be carried out in order for Sweden to achieve the objectives laid out in the previous chapter. The majority of these proposed activities are intended to highlight the area of smart electronic systems, which functions as an enabler for a great number of industries, operations and societal benefits but which is never really seen as its contact with the market and the resulting benefits are masked by the fact that electronic systems initially exist in other activities and industrial applications.

The time frame for these activities differs, but most need to be addressed immediately in order for objectives to be achieved in time and for the overall objective of growth to be realised.

Initially, these activities will be run as part of the operations carried out by the operators mentioned in the agenda. In order to achieve the effects defined in the objectives, however, the activities must be closely connected and financed in a sustainable manner. In the future, we therefore see a need for financed collaborative functions for optimal coordination.

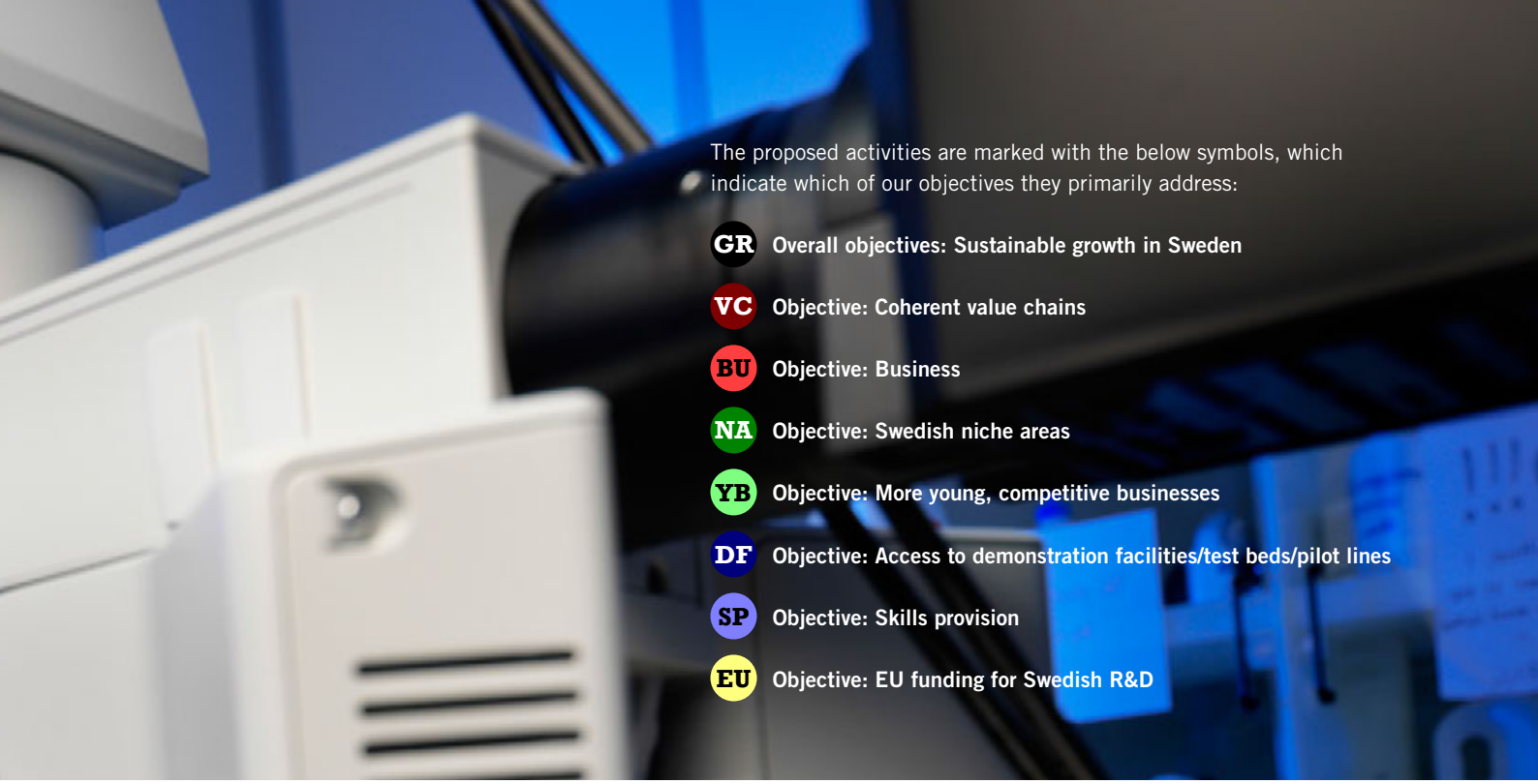
Competence Centres – in general

GR VC BU NA YB DF EU

Sweden needs to invest in competence centres surrounding the select niche areas in order to gather companies, institutions and academia around the prioritisation and demand management of research and development These activities can be run by operators together but require a national investment in which even the Government participates. There are many examples of this in other countries, such as Finland and Korea. These competence centres are to be given an extra responsibility to disseminate their unique expertise among the market areas which can apply it.

■ We propose that the current strong and niche technology areas that are already viewed as strong competence centres take responsibility for and conduct activities geared towards industry, and that these should be coordinated.

■ We propose that the State, through VINNOVA, the Energy Agency and Formas, should renew and expand its previous investments in competence centres, arenas and demonstrator facilities/test beds/pilot lines.



The proposed activities are marked with the below symbols, which indicate which of our objectives they primarily address:

- **GR** Overall objectives: Sustainable growth in Sweden
- **VC** Objective: Coherent value chains
- **BU** Objective: Business
- **NA** Objective: Swedish niche areas
- **YB** Objective: More young, competitive businesses
- **DF** Objective: Access to demonstration facilities/test beds/pilot lines
- **SP** Objective: Skills provision
- **EU** Objective: EU funding for Swedish R&D

Competence Centres – per cutting-edge technology

GR VC BU NA YB DF EU

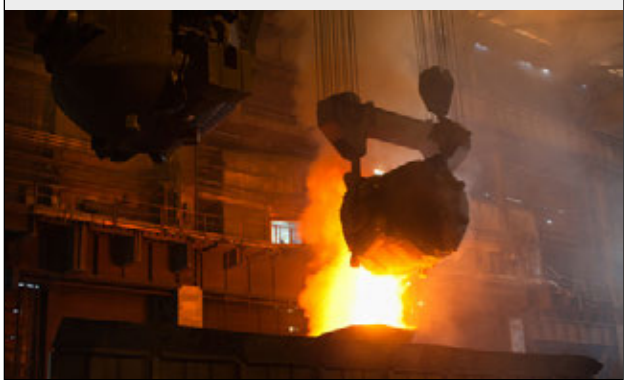
In order to create competence centres, the operators behind the agenda will in 2014 and based on the respective niche area, invite a select group of Swedish operators from the market areas mentioned above to a series of seminars/workshops in which we will define especially important needs and areas upon which Swedish research and development needs to focus.

■ We propose that coordinating activities for the creation of competence centres within our prioritised sub-technology areas be organised by the following operators:

- micro/nanoelectronics – Acreo Swedish ICT (preferably together with SwedNanotech)
- printed electronics – Acreo Swedish ICT and Linköping University (LiU)
- power electronics – Acreo Swedish ICT and KTH
- photonics – PhotonicSweden (and even Acreo Swedish ICT)
- antenna, microwave and terahertz systems – Chalmers (CHASE and Gigahertz Centre)
- sensors – Acreo Swedish ICT
- embedded systems – Branschorganisationen Svensk Elektronik
- assembly technology and reliability – Swerea IVF, Luleå University of Technology (LTU)
- advanced production technology – the Swedish Electronics Trade Association, Teknikföretagen

SWEDEN EXCELS: Measurement methods for the process industry

Using the right temperature in different processes is very important in the steel industry. Despite this, relatively few measurement points are used today, due to extreme temperature conditions. In blast-furnaces, where temperatures exceed 2,500 degrees, measurement was previously impossible. A solution based on specially adapted fibre optics makes it possible to continuously measure temperature in real time at different stages of the manufacturing process. Reduced energy consumption and improved product quality are some of the effects.



To actively monitor, govern and optimise complex industrial processes is one of the challenges for the Swedish manufacturing industry. Fibre optics and associated electronics can solve the problem.

Competence Centres – in sync with the EU

GR NA DF EU

The Swedish niche technologies need to be linked to relevant programmes such as ECSEL and relevant platforms, in close cooperation with operators in the EU. Many competence centres already have links with the EU in their areas.

■ We propose that our proposed competence centres conduct a coordination and systematisation of Swedish efforts to strengthen our impact on the collaboration with operators within the EU.

Arenas for the exchanges of experiences

GR VC BU YB SP

Sweden is a small country and it is important that everyone can learn from one another. Only a few large Swedish companies are big enough to win a share of the global market. For this reason, it is important that:

■ SMEs together create an exchange of experience of various business models and different markets;

■ the major companies are prepared to be "locomotive" and bring Swedish SMEs onto the global market.

This can only happen if there is openness in the Swedish electronics industry.

■ We propose that the Swedish Electronics Trade Association, to an increasing degree in cooperation with other operators, organises meeting places and creative arenas for the exchange of experiences, knowledge and competence.

Sustainable competence in the value chains

GR VC BU NA SP

To proceed from idea to product in our value chains, we must bridge the gap between the different parts, which requires focus in areas where we have no niche knowledge. This includes the stage between component, system and application. On the one hand it is a matter of procurement skills, on the other it is about the capacity to formulate the right offer. Special investments must be made in this area in order to achieve full leverage of the niche technology currently being developed in Sweden.

■ We propose that the Swedish Electronics Trade Association, to an increasing degree in cooperation with other operators, organises workshops/seminars in order to strengthen the sustainable competence in the value chains.

Knowledge to SMEs

GR BU NA YB DF

SMEs need to have the opportunity to benefit from new knowledge from their own development, in close cooperation with the Swedish niche technologies. Acreo Swedish ICT, Swerea IVF and other institutions conduct targeted investments for increased dissemination of knowledge about the Swedish niche areas.

■ We propose that the State finances programmes (like minST, teknIQ and ESIS) so that new technology can be actively passed on to SMEs, and so that a forward-looking image of market requirements can be created.

SWEDEN EXCELS: Effective electricity supply networks

The sustainable society of the future will mainly use renewable energy sources such as solar, wind and hydropower, which due to smaller quantities of energy will result in greater losses across the network. Power electronics manufactured with the new material silicon carbide instead of regular silicon will lead to great advantages in the smart, distributed energy systems of the future, as the technology, if used correctly, can reduce energy losses occurring during distribution by 50 %. The systems can be made very well integrated and compact, compared with silicon-based systems, and this improves economy and usability, for example when installing in inaccessible environments, or simply in order to make the technology consumer-friendly for the use of private persons who are just as likely to be energy producers as consumers.

The scale of the operations of both energy producers and consumers is becoming ever smaller. This results in greater losses in the distribution systems, which places greater demands on smart electricity supply networks.

SWEDEN EXCELS: Printed biosensors

In the care sector of today, access to diagnosis in the home is in increasing demand – and not purely to save costs; carrying out tests in a stress-free environment such as the home also produces better measurement values. An integrated biosensor contains biological or synthetic components that react to e.g., a drop of blood. The reaction is transformed into an electronic signal that is proportional to the content of the target substance. The results of the measurement can be immediately viewed on the display. The next step in the research is to create sensor systems in which the results of the analysis are directly forwarded via a mobile network, for example to the doctor waiting for their patient's results.

Biosensors that can be used to check a person's health and warn of any illness will soon be able to fit in our pockets. By printing them on plastic or paper, we can manufacture them at next to no cost.

Swedish electronic systems EU grants offices

GR VC BU NA YB EU

The objective of getting more SMEs involved in EU projects requires "Swedish electronic systems EU grants offices", which can only be realised with external financing. A general "SME grants office" would not work, since the personnel required would need to have a sound or even excellent knowledge of the Swedish electronics industry and the niche technologies that exist among Swedish institutes and academia.

■ We propose that the programmes proposed above are used to implement the externally financed "Swedish electronic systems EU grants offices" – with the objective of increasing the participation of SMEs in EU projects.

SMEs in EU projects

GR VC BU YB EU

A support system is needed if the proportion of Swedish SMEs that participate in EU-funded research projects is to increase. Within institutions and academia, activities are conducted today in order to create such support, but in the form of a "push", i.e., the operators look for SMEs and attempt to include them in projects that have already been defined. We also need to create a "pull" effect, i.e., strategic demand among companies that are dependent on electronic systems for their manufacturing/activities.

■ We propose that the companies operating within smart electronic systems coordinate their current activities in order to improve strategic demand and, consequently, the operating conditions for SMEs. This type of mapping should initially be conducted via seminars/workshops.

Demonstrator facilities/test beds/pilot lines

GR VC BU NA YB DF

Demonstrator facilities/test beds/pilot lines need to be made available to new companies and companies that do not have their own facilities. In this way, companies can test their business ideas and formulate their offers before they are forced into major investments in their own production.

■ We propose that Myfab should be the model for how we organise the utilisation of test beds. Myfab is a Swedish Research Council-supported infrastructure that, over the course of several years, has developed a specific approach in respect of how these types of facilities should be operated. Acreo Swedish ICT, Chalmers, Uppsala University and KTH are leading the requisite transfer of knowledge.

■ We propose that the operators behind Myfab conduct an inventory of existing facilities in Sweden.

■ We propose that the operators behind Myfab conduct an inventory of whether suitable conditions exist that would allow operators, institutions, businesses and higher education institutions to open up their demonstrator facilities/test beds/pilot lines to companies.

■ We propose that the State investigate the possibilities for financing this more open infrastructure in the future.

Skills provision

GR VC BU SP

Skills provision is a critical success factor for growth. Without the regrowth of competent personnel, we will not achieve the objectives we are aiming at. In the flora of study programmes, there must be enough places to allow students to enter the industry, especially as far as electronics is concerned. This also places demands on current and future expertise in electronics among teachers at both high school and university level.

■ We propose that the organisation Teknikcollege.se should develop and make the concept of technology colleges with an electronic specialisation accessible on a broader front than is currently the case.

■ We propose that industry and higher education institutions establish collaborations whereby trainee positions can be created and degree projects completed.

■ We propose that industry and higher education institutions work together to develop a mentorship programme for higher education students within the field of smart electronic systems.

SWEDEN EXCELS: Night vision

The improvement of safety for all of us in different ways is important, especially in our globalised world. Seeing in the dark with infrared light has become one of Sweden's areas of strength. Operators within Swedish electronics R&D currently work with security systems based on heat cameras. Having gone from being an expensive, high-performance technology primarily for military applications, the technology is now spreading to more and more areas in line with the development of micro/nanoelectronics, e.g., night vision in cars.

Future applications may include night vision via mobile phone for personal safety or to avoid loss of heat in the home.

Supporting structure

GR VC BU NA YB DF SP EU

The third operator in the innovation system, society, is responsible for and controls a number of functions important for innovation and growth in the area of smart electronic systems, and is also responsible for ensuring that more young and competitive businesses are formed and that existing businesses grow. A few such areas are financing, education/skills provision, climate for entrepreneurship and legislation that affects the industry. In the 2013 version of this agenda, we have chosen to focus on the following areas.

Entrepreneurs are in short supply. By building a protective network and rewarding individuals who have the courage to take risks, more people will follow the path of entrepreneurship. The tax system will not only reward talented sporting personalities but also talented entrepreneurs. This is especially important in capital-intensive sectors such as the electronics industry.

It is important that there is a functioning market for risk capital in Sweden. Greater focus on electronic systems will allow the establishment of companies. Conditions for this are greater knowledge of electronic systems and their potential in the hands of existing operators. The risks are perceived by the operators to be large, but the gains can be gigantic.

Swedish SMEs must be allowed to grow. Current regulations contain built-in obstacles to expansion.

■ We propose that the State create conditions whereby, for example, employees and employers are entitled to equivalent unemployment compensation and healthcare benefits.

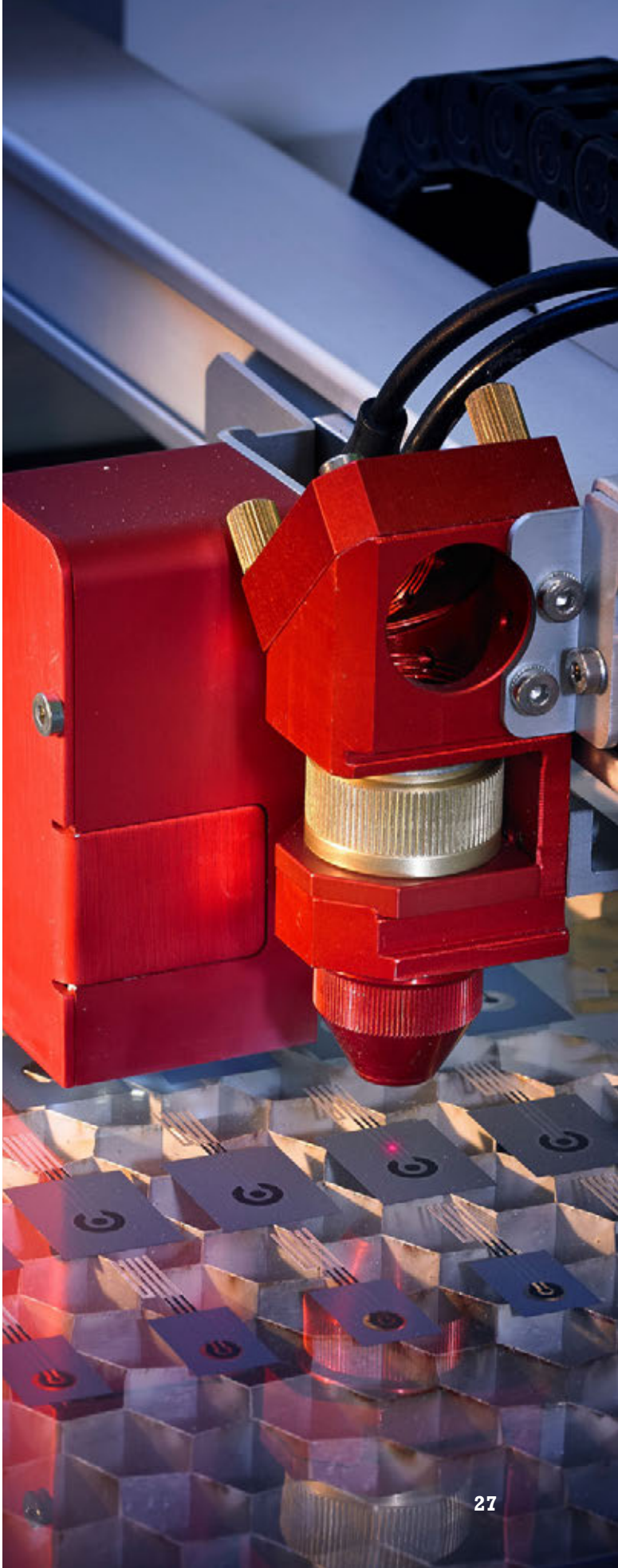
■ We propose that consultation groups be established between the various operators involved with innovation systems, at a central and regional level: the Government, the Riksdag, the regions, private industrial companies, institutions and higher education.

Interim board

GR VC BU NA YB DF SP EU

The work on the agenda has brought the involved parties closer together and entailed a large exchange of experience in the various parts of the area of smart electronic systems. Some form of coordination will be required to maintain the community that has been created and to monitor, coordinate and in some cases manage the activities proposed in this agenda. The board must handle the measurement of objectives!

- We propose that an Interim Board with representatives from the various parties within the field of smart electronic systems be appointed, in order to build on the exchange of experience resulting from the agenda work already conducted, and to coordinate the planned activities.
- We propose that this Interim Board be replaced by a permanent Board in 2014.



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