

CESIS = Centre of Excellence for Science and Innovation Studies

Applicant: Börje Johansson, Division of Economics KTH

1. Objectives

The main objective of the Centre of Excellence for Science and Innovation Studies (CESIS) is to carry out systematic, peer-reviewed research of innovation systems, and to transform the evidence-based findings to decision-support for innovation policy making in the Swedish society. Specific objectives are to:

1. develop an internationally recognized centre of excellence for science and innovation research
2. build-up and communicate a research-based pool of knowledge, with theoretical and empirical support, for the design and implementation of policies for innovation and sustainable growth
3. extend existing and establish new networks of researchers, policy makers and other stakeholders for exchange and dissemination of research results, new knowledge and cooperation.

CESIS will adopt an approach to innovation systems research that comprises systematic analyses of dynamic interdependencies in the development of firms, their industries, interaction networks and institutional milieu. Evidence-based knowledge is derived from time-series observations of individuals, firms, sectors, regions and pertinent networks – including data combined for cross-country comparisons. The analyses should generate a better understanding of sectoral innovation systems ranging from entrepreneur and firm perspectives to international contexts. The focus areas is sectoral innovation systems, comprising the role of international networks and innovative small and medium-sized companies.

Innovation policies may consider two alternative perspectives: (1) remedy of market failures and (2) stimulation of the co-evolution of knowledge, innovation, organizations and institutions. CESIS will stress evidence-based findings pertaining to the latter policy area, i.e. co-evolution. The associated policy objective is the development of sectoral and regional networks in which individual firms can move into states of persistent and sustainable innovation.

2. Purpose

The purpose of CESIS research is to formulate the innovation systems (IS) approach in such a way that it allows for controlled, systematic empirical quantitative analyses, from which decision-support for innovation policy can be designed. Thereby CESIS responds to VINNOVA's overall demand for quantitative measures in IS analyses, and for research which produces knowledge that can give input to and provide new perspectives on the development of innovation policy at various levels.¹

To achieve this, CESIS will adopt network formulations where an innovation system can be depicted as a set of network layers, where links on each layer can be distinguished with regard to durability, content, types of information, nature of interaction, etc. The network description should depict the interaction between pertinent actors. Each network is formally a set of actors and the links connecting them. A link can be seen as a special type of channel for communication and other forms of interaction. Operationally this may include ownership structure, market transactions which can build on long- or short-term contracts, formal and informal collaboration, as well as groupings of actors from policy, research and industry.

The described network approach will guide empirical assessments of how firms interact with its environment including innovation systems actors, and be formulated such that it can be translated to empirical contexts with register data at various levels of aggregation (micro, meso and macro), and complemented by interviews with selected IS actors.² Over the last five years, CESIS has developed and secured access to uniquely rich data at the level of individuals, firms, sectors, regions with information about national and international transaction networks, patent citations, labor mobility, ownership networks, collaboration networks from innovation surveys, etc. At the same time, CESIS researchers have developed skills to conduct empirical innovation studies with the described data material. CESIS research approach is designed to explore these data from an IS perspective in novel ways and develop research-based knowledge which can guide the design of sector, region and firm-specific policy, while contributing to the scientific literature on innovation and growth.

¹As formulated by VINNOVA in "VINNOVA programme – Impact of Innovation Policy on Sustainable Growth", dated 22/02/10.

²This also corresponds to the demand for quantitative knowledge at different levels of aggregation, expressed by VINNOVA in the programme documents. CESIS strategy to complement econometric analyses with interviews is meant to help interpret results, and is partly inspired by the ideas in the book "Putting econometrics in its place – a new direction in applied economics" by Peter Swann. An example is provided by CESIS WP 154 titled *Multinationals in the knowledge economy – a case study of AstraZeneca in Sweden* (<http://ideas.repec.org/p/hhs/cesisp/0154.html>).

3. CESIS research approach and focal areas

CESIS was awarded the status of a Centre of Excellence in the last programme period and was founded in 2004. During the first period of the programme, CESIS has established itself as a research centre internationally as well as nationally. This is reflected in a variety of ways. According to the worldwide REPEC-system, for instance, CESIS ranks high in terms of research output and research impact. CESIS is among the top 10 % research institutions in Sweden, among the top 5 % institutions in the world focused on innovation research. Several of CESIS researchers rank high and publish in top journals. Moreover, CESIS has established strong international networks and recently signed formal agreements with the School of Public Policy at the George Mason University in the US as well as Hitotsubashi University in Japan for collaboration in innovation and entrepreneurship research. The centre has also been visible in the public debate and amongst innovation policy makers with reports for e.g. the Swedish Globalization Council, VINNOVA, Forum for Reforms, Entrepreneurship and Sustainability (FORES), Swedish Agency for Economic and Regional Growth, Chambers of Commerce, Growth Analysis Agency and AstraZeneca in Sweden.

For this second period of the programme, CESIS designs its approach to innovation systems research to meet VINNOVA's call for implementation-focused research agendas in response to the evaluations of the first programme period. This section describes and motivates the revised CESIS research strategy, explains how it builds on, extends and improves the CESIS research as developed during the first period of the programme, as well as outlines focal research areas. The relationship between the proposed research and the international research frontier is clarified and it is made clear how the CESIS research will contribute to research-based policy decisions. The section starts by describing CESIS' overall research approach and then goes on to present focal areas and specific research questions.

3.1 CESIS research approach

Background

The concept of *innovation systems* (IS) was formulated by Lundvall (1985) but a similar idea can be found at least as early as in List 1841 (The National System of Political Economy). The concept has been found as an attractive tool for studying interactions within a wide range of areas. Early contributors to the development of the modern definition include Freeman (1987), Lundvall (1992), Nelson (1993), Patel and Pavitt (1994), and Metcalfe (1995). Today the innovation systems approach is frequently used among both different branches of scientific researchers and policy makers.

The systems approach helps to organize innovation policy activities and provides a holistic description of the nexus of innovation and growth, including industry, academia and policy

institutions. A central idea is that the economic performance of nations, regions, etc. depends not only on how firms perform, but also on how they interact with each other and with the public sector in knowledge creation and exchange. The approach stresses *systemic interactions* between the various components of inventions, research, technical change, learning and innovation (Soete et al. 2009).

The IS approach is not a formal theory, but a conceptual framework in its early stage of development (Fischer 2001). This is reflected in several ways. First, there is no general agreement on which elements and relations are essential to the conceptual core of the framework and what is their precise contents (Edquist 1997). There is a lack of clarity regarding the function or purpose of each system, and what constitutes inputs and outputs of the system (Carlsson et al. 2002). Second, the concept is 'open-ended'. System boundaries may be defined in terms of geography, technology, sectors, etc. The literature offers conceptualizations and studies of innovation systems at a variety of levels, such as national, regional, sectoral, technological, spatial and metropolitan.³ Fourth, the current literature does not provide a common point of departure for an innovation systems theory to be developed (Soete et al. 2009).

Partly in response to the above, empirical research on innovation systems lacks consistency in terms of operational definitions and principles. The general level at which innovation systems are defined conceptually implies that translations to empirical contexts often are difficult. This is especially the case for quantitative analyses of register and survey data, which provide information on several firms active in different sectors. For instance, the IS approach provides little guidance for econometric analyses based on large samples of firms. The bulk of empirical innovation systems analyses rely on historical analyses of specific sectors, countries or regions. This is one reason why much of CESIS research output during the first programme period has not explicitly referenced the concept of innovation system, though the research has been highly relevant for enhancing innovation systems knowledge and policy.

CESIS innovation systems approach

CESIS innovation systems research approach is developed to meet the call for revised research agendas in the programme documents by VINNOVA, while at the same time ensuring that assets, such as extensive innovation databases, built up during the first period can be used to test hypotheses and conjectures associated to the revised research agenda. Specifically, the CESIS innovation systems approach is designed to:⁴

³See e.g. Lundvall (1995), Nelson and Rosenberg (1993), Cooke et al (1997, 1998), Breschi and Malerba (1997), Carlson and Stankiewicz (1997), Fischer et al. (2001), Maskell and Malmberg (1999) and Malecki and Oinas (2002).

⁴In following the revised research agenda, CESIS aims to continue to exploit research assets developed during the previous programme period, and elucidate how CESIS empirical research associates to innovation systems.

- allow for controlled, systematic quantitative analyses of innovation systems at different levels primarily using register and survey data on firms, sectors and regions, while confronting quantitative results with interviews of selected firms and other IS actors
- analyze interaction effects between various levels, e.g. how R&D strategies of innovating firms influence an aggregate sector or a region/country as well as how sector and market characteristics influence firms' innovation strategies⁵
- assess the evolution of firms, sectors and regions over time, and the role of dynamic interdependence in these processes
- select research questions that spring from issues and problems experienced in VINNOVAs innovation support activities and programmes
- develop knowledge that will enhance the prerequisites for research-based decisions about innovation policy in the Swedish society

CESIS approach to innovation systems research is based on network formulations of innovation systems. All networks have in common that they have objects (firms, sectors, universities, policymakers) tied together in a connectivity structure by links. One can abstractly regard a network as a system (Casti 1995): *network = objects (nodes) + connections = system*.

In a network perspective innovation systems are composed of links and nodes, which have different characteristics and may be catalogued into different types. Links between firms and universities, customers, etc., may for instance be characterized in terms of capacity, durability, contents, types of information, nature of interaction.⁶ Networks also have different layers, which correspond to the notion of different levels of analysis (e.g. micro, meso, macro). There are three general layers: (i) firms, (ii) sectors and (iii) economy-wide conditions (Figure 1).

⁵CESIS is currently undertaking a large-scale project titled "Innovation and Growth – from R&D strategies of innovating firms to economy-wide technological change" that addresses these issues directly. The project results in a book at Oxford University Press edited by CESIS researchers, with leading innovation researchers from the US and Europe as contributing authors.

⁶Gelsing (1989) identifies four types of networks of firms: (1) user-supplier relations; (2) the production chain or line of value added (vertical chain); (3) production complexes; and (4) knowledge networks. The difference between 'production complexes' and 'knowledge networks' is that the former focus on the exchange of material resources, whereas the latter focus on information and knowledge, though links for flows of material resources may of course bring about the latter.

Each individual firm may be described as the nucleus of its own firm-specific innovation system and it makes strategic decisions about its own network components and configuration, and its own resource-base. As an example, it is well-known that one of the motives behind MNEs decision to locate R&D facilities abroad is to build network links to leading research institutions and universities, i.e. knowledge augmenting motives (Narula 1999, Narula and Zanfei 2004, Criscuolo et al. 2005). Firms represent the micro-level in the CESIS network approach to innovation systems and may be characterized according to innovation strategy, resource base, transaction, knowledge and collaboration networks.

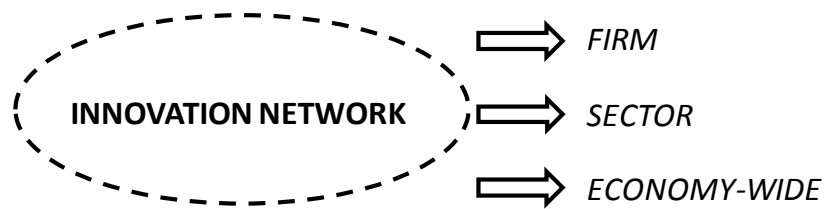


Figure 1. *Layers of Innovation Networks*

Sectors correspond to the meso-level and provide firms belonging to the same sector with common institutional characteristics. They can be defined in two alternative ways: (1) product group or market characteristics and (2) technology relatedness. The first type of definition resembles the standard industry classification scheme such as NACE, where firms are grouped according to their main industry code. Alternatively, classifications can be based on product group codes. The type of definition (2) builds on the type of technology firms use, where firms are grouped together based on the technology class of their patents. Considering that we can identify specific networks for individual firms, sets of firms have overlapping networks, especially when they enter strategic partnerships. The presence of such nested networks is an important aspect of sectoral innovation networks.

Economy-wide networks are important in tracing the sequential impacts on firms in other sectors. The compound effect of this type of repercussions constitute technological change that include both add-on effects and creative destruction. For example, food industry innovations are associated with changes in agriculture, chemistry and packaging industries and may give rise to new inter-sector links.

CESIS research will employ empirical methods to identify and assess the importance of different connectivity structures for innovation at the firm, sector and economy-wide level. This comprises (1) assessments of the general role of links to suppliers, customers, collaboration partners, etc., for innovation processes and their outcomes and (2) analyses of the importance of different attributes of links and nodes. For the latter type of analysis, it should be recognized that links can be distinguished in terms of type and nature of interaction (e.g. collaboration, sales and/or purchases of goods and services, ownership),

durability, density, content.⁷ The same applies to nodes, such as customers, universities, other firms, which all differ according to several dimensions.

CESIS research comprise both static and dynamic analyses, where the latter focuses on characterization of the dynamics of innovation efforts and consequences at various layers of networks. The program documents explicitly call for dynamic analyses, and CESIS approach to dynamics builds on a the idea that it is essential to distinguish between phenomena that change according to different time scales, going back to basic theorizing on self-organizing systems, synergetics and evolutionary economics (Nelson and Winter 1982, Haken 1983).⁸

An essential feature of self-organizing systems is that temporal and spatial patterns evolve endogenously without being imposed on the system from outside. Of special importance is the interaction of coupled subsystems which adjust on different time scales, as is the case for the different network layers. A typical separation of time scales obtains if we consider that the development of a firm's resource base, collaboration networks and strategic behavior may evolve on a slow time scale, whereas the market response to new products or to investment options may adjust on a fast scale. This implies that research strategies can be designed to detect phase transitions in response to firm strategies, which may change macroscopic (economy-wide) behavior over time (Batten, Casti and Johansson 1987).

The established technique to organize tractable analyses of interacting systems that operate on different time scales, such as different layers of networks, is to make use of so-called adiabatic approximations and the slaving principle. In essence, this means that slowly changing variables are treated as parameters when the fast processes are modeled, while modeling the slow variables with the approximation that the fast variables adjust instantaneously to the motion of the slow variables.

The described dynamic approach will permeate the CESIS research program, though it is especially pertinent for the analysis of interaction between network layers, i.e. firms, sectors and economy-wide conditions. This research line builds upon the forthcoming book "Innovation and Growth – from R&D strategies of innovating firms to economy-wide technological change" edited by CESIS researchers. The underlying idea is that the R&D strategies of firms at the micro-level have implications for the development of sectors as

⁷As an example, two different firms may have collaboration with the same university, but one of the firms collaborates temporarily whereas the other collaborates persistently. In this case, the firms differ in terms of a link attributes. A similar reasoning applies to nodes such as customers, universities, collaboration partners, etc. Nodes differ in terms of characteristics and attributes and thus the same type of links to different nodes may have varying influence on innovation processes and outcomes.

⁸Schumpeter's notion of novelty refers to phenomena such as the emergence of new needs and changing preferences as part of social learning processes, the development of new products satisfying consumer needs, the use of intermediaries and equipment in changing and improving production processes, the adoption of new organizational strategies and the opening of new markets. These perspectives have promoted the formation of evolutionary economics, with reference to self-organizing systems and synergetics.

well as economy-wide technological change. At the same time, economy-wide conditions and sectoral characteristics may exert a strong influence on the R&D strategies undertaken by innovating firms. The interaction between these levels may be described as co-evolution, characterized by dynamic interdependence. Such interdependence is captured by the theory of dynamic systems which is rooted in analytical dynamics reflecting transformations in real-world systems. Thereby it has an evident coupling to the analysis of innovation, technological change, creative accumulation and creative destruction, and is designed to analyze and predict (structural) dynamics of economic systems and generate various trajectories for the evolution of the system, in which both endogenous and exogenous fluctuating patterns may play a role.

A research tool to analyze effects at different time scales is wavelet analysis. Wavelet analysis is a quite recent technique in economics and has mainly been used in empirical financial macroeconomic analyses. The application of wavelets is a novelty of CESIS research program and is a response to the described approach to dynamic analyses. The last years, CESIS has developed a competence in wavelet analysis which will be applied in the context of innovation analysis at different levels.⁹ In principle, wavelets can be compared to a wide-angle camera lens that allows one to take broad landscape portraits as well as zoom in on microscopic detail that is normally hidden to the human eye. The technique cuts data into different frequency components for individual analysis. This scale decomposition opens a whole new way of processing data. As Graps (1995) states, wavelets enable us to see both the forest *and* the trees.¹⁰ At high scales, the wavelet has a small time support, enabling it to zoom in on details such as spikes and cusps, and on short-lived phenomena such as delta functions. At low scales, wavelets capture long-run phenomena. Their ability to adapt their scale and time support enables them to escape Heisenberg's curse; i.e., the law that says that one cannot be simultaneously precise in the time and the frequency domain. Wavelet analysis is itself an innovative component of the battery of empirical techniques that CESIS applies in its research.

3.2 Focal questions

CESIS research associates to many research areas highlighted in VINNOVAs programme document, but the focal questions pertain to sectoral innovation systems, international networks and innovative SMEs. The focal questions of CESIS research span six work areas.

⁹See e.g. CESIS WP 227, WP 217, WP 215 and WP 184 at <http://ideas.repec.org/s/hhs/cesisp.html>.

¹⁰A wavelet basis consists of a father wavelet that represents the smooth baseline trend and a mother wavelet that is dilated and shifted to construct different levels of detail. This resembles the building plan of a natural organism that is based on self-similarity.

Work Area 1: Dynamics of firms' innovation efforts – strategies, resource bases and evolution

In both manufacturing and service sectors we can observe that a large share of all firms do not allocate resources to R&D and alike innovation efforts and that another group enters into innovation activities occasionally. Only a smaller set of firms spend resources on innovation persistently over extended time sequences. This work area relies on the theoretical building blocks of evolutionary economics and assesses the dynamics of firms' innovation efforts. The research pertains to policy which aims (i) to support the transition of firms to alternative innovation strategies with long-term R&D commitments and to (ii) develop and restructure innovation networks of firms. The work area will deliver knowledge of how firms develop resource bases over time, and the role of R&D and network assets (links, nodes and their attributes) in these processes.

In the traditional view innovation has only transitory effects on firms' profitability and growth by altering its competitive position in the short run. The introduction of innovation gives the firm a temporary monopoly power by increasing firms' market-share, which allows for higher profit until other firms can imitate the innovation (Aghion and Howitt 1992, Klepper 1977). This approach is for instance common in the literature on first mover advantages and on patent races.

A second approach emphasizes that innovation intrinsically 'characterizes' a firm in that it creates a structural difference between innovating and non-innovating firms. Each firm is assumed to own different technological competencies that are firm-specific, difficult to imitate and emerge cumulatively from learning processes. A firm's internal competencies together with its strategic behavior enable it to innovate, grow and survive in the market (see e.g. Malerba and Orsenigo 1995, Cohen and Levinthal 1989, Dosi et al. 1995). This approach corresponds to the resource-based view of the firm (Penrose 1958, Barney 1991).

The work area adheres to the second view and associates to problems of dynamic interdependencies and true path dependence¹¹ in the evolution of firms and their capabilities and innovativeness. The research will carefully specify the time scales for different change processes, and uses econometric techniques complemented by interviews of selected firms to assess interdependencies. By interacting with a set of international research collaborators CESIS expects to advance existing research methods and econometric techniques to develop new insights into the role of R&D strategies and networks for productivity, evolution of capabilities and growth. The work area relates to the research frontier on the inter-connection of strategy, R&D, firm capabilities, networks and growth (see e.g. CBO 2005, Dosi and Nelson 2009, Cefis and Orsenigo 2001, Peters 2009 as well as

¹¹ True path dependence is in contrast to spurious path dependence in panel data models, see e.g. Heckman (1981).

Lööf and Johansson 2010). Methodologically the research area includes development of structural models, introduced by Lööf and Heshmati (2002, 2006).

The work area also associates to the recent literature on the role of sector and firm characteristics for innovation, which puts into focus their relative role in explaining innovation (see e.g. Peneder 2010, Srholec and Verspagen 2008). Firm data on innovation and performance consistently show much heterogeneity of behavior among individual companies. At the same time, sectoral data repeatedly demonstrate persistent and significant differences between sectors, e.g., with respect to average factor intensities, dominant corporate strategies, entry rates, or firm duration. For example, Malerba (2007) points at the apparent tension between these two stylized facts: while the first stresses variety, the latter emphasizes common contingencies among firms operating within the same markets. In most empirical analyses the tension between the micro- and the meso-levels of observation largely remains unresolved. Persistent differences between sectors draw attention towards specific technology fields, where observed regularities in industry data are interpreted as if they represent the behavior of the individual firms. Conversely, the variety of firm behavior causes many researchers to focus exclusively on micro-data, frequently discarding any aggregate levels of analysis.¹²

Work area 1 will deal with the following issues:

- Temporal analysis of innovation efforts and economic performance, including application of wavelet techniques
- Time scales for resource-base development vis-à-vis firm performance, including application of wavelet techniques
- Transitions from non-persistent to persistent innovation efforts – probability and explanatory characteristics
- The role of network characteristics for firms' resource-base and innovation performance, including networks for goods and services as well as knowledge networks
- The relative of role of firm and sector characteristics for in explaining innovation and R&D strategies of firms

¹²This issue has practical implications for innovation policy (Peneder 2010). On the one hand, without a proper understanding of the co-evolution of variety and contingency government authorities are easily misled into an obsession for 'high-tech' industries. A biased perception of innovation potentials can thus lead to the misallocation of public funds, if, for example, innovative companies in traditional sectors find it more difficult to access public funding than firms with lower innovation potential in a 'high-tech' industry. On the other hand, industry characteristics matter and cannot be ignored. Their accurate understanding helps to design policy programs and tailor them more effectively to the needs of targeted firms.

The work area will employ firm-level register data with detailed information of the firms and their sectors and locations, export and import flows to and from different countries together with a sequence of Community of Innovation Surveys (CIS).

Work Area 2: International networks, export performance and innovation of firms and sector-grouped firms

The last five decades have witnessed an increasing role of international networks for firms, sectors and regions. The world economy is 'globalizing', bringing about a growing interdependence of economies, involving consumers, producers, suppliers and governments in different countries.

International networks are important in at least two ways. The first is that they are a vehicles for sales on foreign markets, and thus export revenues. In a small open economy like Sweden, openness – as measured by the total value of exports plus imports as a fraction of GDP – has increased from just above 20 % in the 1950s to over 90 % in the 2000s, and net exports contribute substantially to Sweden's GDP (export revenues exceed imports). Also, international markets (exports) have grown in importance for many firms, SMEs as well as large firms (see e.g. OECD 1997). Andersson et al. (2008) show with Swedish firm-level data that 76 % of all firms in Sweden in manufacturing sectors are engaged in international trade, and that more than half (55 %) both exports and imports. Lööf (2010) reports that half of the Swedish firms exporting goods are service firms and that they account for a substantial and increasing share of the total value from exports of goods. Between 1997 and 2006 this fraction increased from 25 % to 34 %. Hence, international networks are important for generating revenues as well as securing input deliveries and product varieties from other countries.

The second way in which trade is important is that international networks are channels for knowledge and information flows. The endogenous growth literature has identified various channels of international knowledge spillovers. Based on the models of Grossman and Helpman (1991) and Rivera-Batiz and Romer (1991), recent studies have documented R&D cross-country knowledge spillovers through trade as an important engine of TFP growth in the industrialized countries. Eaton and Kortum (1996) suggest that even a large economy like the United States obtains over 40 percent of its growth from foreign innovation. Keller (2002) uses data that cover more than 65 percent of the world's manufacturing output and most of the world's R&D expenditures, and show that 20 % of the productivity of an industry in a country can be attributed to R&D expenditures in foreign industries, accessed through import flows. Though this literature more often than not focuses on imports of capital goods as a vehicle for technology flows, recent firm-level analyses also find that firms' engagement in international trade have positive feedback effects on firms, so-called 'learning-by-

exporting' (see e.g. Andersson and Lööf 2009, Baldwin and Gu 2003, Fernandes and Isgut 2007, Greenaway and Kneller 2008).¹³

Work area 2 will assess the role of international networks in the form of exports and imports from both of the ways described above. First of all, the work area comprises studies where consequences of innovation efforts are measured in terms of export performance, where the latter may be recorded as network links to different destination markets, export value flows across destination links (e.g. Andersson and Johansson 2008, 2010), product quality measured as unit price premium across export links (e.g. Aiginger 1997, Andersson and Ejermo 2008, Johansson 2010), number of product varieties in the total export flow and specified for different destination links.¹⁴ Second, the work area includes studies that assess export and import flows as vehicles for technology diffusion, and will pay special attention to the role of link (e.g. temporal and product characteristics of export and import flows) and node attributes. Node attributes are essentially characteristics of destination and origin countries, where it should be observed that Acharya and Keller (2007) find that the combined effect of R&D investments in countries close to the world's technology frontier is on average about three times as large as that of domestic R&D. In contrast to the bulk of the existing literature and as called for in the research literature (see e.g. Keller 2004), CESIS will primarily undertake firm-level analyses while considering the importance of industry and product-group aggregates. Third, the work area includes studies that assess the interdependence between innovation efforts and engagement in international trade. These analyses will draw on recent theorizing on the interaction between firms' decision on innovation strategies and their decision to enter export markets (see e.g. Costantini and Melitz 2007 and Aw et al. 2008). In these models the interdependence goes in principle as follows: firms invest in R&D and physical capital, which can affect the path of future productivity for the firm. R&D investments, through their effect on productivity, increases the profits from exporting, and participation in the export market in turn raises the return to R&D investments.

Work area 2 will deliver knowledge of the role innovation efforts play for export revenues and GDP at the aggregate level, and what firm attributes and milieu characteristics are important for firms' decision to participate in international trade. It will provide policy-relevant knowledge of international trade networks as vehicles for knowledge and technology diffusion. In general, these aspects are important for a small open economy like Sweden, where a large fraction of the firms are engaged in trade and export revenues are

¹³Typical arguments are that exporting firms may accumulate knowledge and technology from their activities in foreign markets, such that exports have positive effects on firms' knowledge and technology accumulation (Wagner 2007), that foreign buyers may provide product designs and technical assistance to domestic suppliers in order to improve the efficiency of their sourcing activities (Evenson and Westphal 1995) and that exporting may imply the reduction of X-inefficiencies and stimulate the renewal of development and production processes (Greenaway and Kneller 2007).

¹⁴ A special category of firms is those forms which belong to multinational company groups, since these firms has their internal company group networks, while also having to decide where to locate their R&D facilities.

important for GDP. A specific policy issue concerns the interdependence between exports and innovation outlined above. The described interdependence imply for instance that export support can stimulate innovation efforts (large markets raise returns for R&D investments, which may be viewed as fixed costs), while R&D support may stimulate firms' to export. This may suggest for instance that R&D support could be complemented by export support, and suggest a general interaction between innovation and export policies (e.g. VINNOVA and the Swedish Trade Council).

Work Area 3: Knowledge flow networks and innovation results for different sectors

Competitiveness and innovation is to a large extent dependent upon the ability to apply new knowledge and technology in products, services and their production processes. The creation and the diffusion of new ideas are processes which imply the integration and recombination of existing knowledge coming from different sources, locations and organizational positions. With rapid advancement of knowledge and technology, firms need to secure access to knowledge and information, and 'knowledge flow networks' play an important role in this context.

Within industrial economics and business studies, knowledge network concepts have been applied to the theory of the firm (Kogut 2000), to studies of organizations (Burt 2003), and to the analysis of strategic alliances for research, technology transfer, and standard setting (Andrews and Knoke, 2001). Yet, as Breschi and Lissoni (2004) remark, despite the frequent use of the knowledge network concept, quantitative research is still in its infancy.

The current work area will focus on assessing the role of knowledge flow networks for innovation and growth of firms, sectors and economy-wide. Knowledge flow networks refer to measurable flows associated to knowledge and information, and the work area focuses on knowledge flows as evidenced by patent citations, mobility of engineers and skilled labor as well as university graduates. For this, CESIS will employ firm-level EPO Worldwide Statistical Database (PATSTAT) including citations, matched employer-employee data and data describing interaction opportunities across space with spatial accessibility measures. In the accessibility analyses, CESIS will employ its developed techniques for estimating knowledge accessibility for different sectors and firms. International comparison using PATSTAT will rely on firm-level statistics from Compustat and AMADEUS databases as well as direct collaboration with other countries having access to registerdata on firms characteristics and trade statistics.

The use of patent citations has quite a well-established tradition in the economics of innovation. First, citations have been used along with patent re-classification and co-word analysis when searching for technology families, and comparing the knowledge base of different companies on the basis of their patent portfolios (Pilkington, Dyerson and Tissier

2002). Second, citations have been used to assess the quality of individual patents, which has been shown to increase with the number of citations received (eg. Ejeremo 2009). This allows evaluating the economic value of companies' patent portfolios. Third, citations have been increasingly interpreted as 'paper trails' left by knowledge flowing from the inventor or applicant of the cited document to the inventor/applicant of the citing one (Jaffe et al 1993). Moreover, patent citations analyses are also used to examine patterns of technical change in large technology systems. Fontana et al. (2008) state that identifying the structure of patent citations in different technology fields or sectors makes it possible to assess the main trajectories that have characterized its evolution.

In this work area, patent citations will primarily be used to identify knowledge flows from and to firms. Connectivity structures based on patent citations will be matched with the structure of international trade flows, flows of engineers and R&D workers and spatial accessibility measures describing the potential for interaction. This allows for an assessment of the correspondence between indirect knowledge flow networks and more direct measures. Mobility of knowledge labor between firms will be identified by Swedish matched employer-employee data.

Work area 3 will assess the following research issues:

- Patent citations as components in innovation networks of firms, sectors and countries
- Correspondence between knowledge flow networks, as evidenced by patent citations, and international trade networks, mobility of people and spatial accessibility measures
- The role of labor mobility for firms' resource bases and innovation behavior
- Patents, citations and economic performance of firms, and aggregate of firms grouped by technology fields and sectors
- Accessibility measures that reveal the potential for knowledge flows across space to explain product development and other innovation efforts.

Work Area 4: The role of knowledge-intensive service sectors in innovation networks

Both large and small urban regions in the OECD group of countries are rapidly being transformed to economies that have an expanding share of services as well as an augmented knowledge intensity of the labor force. The change is clearly more accentuated in large agglomerations, and productivity and wage levels increase faster in places with a larger share of – in particular – knowledge intensive producer services, often referred to as KIBS (Storper and Venables 2004). This change process seems to reflect outsourcing of both standardized and knowledge-intensive services.

The growth of business services represents a qualitative new stage in the social structure of production in that firm-level scale economies with regard to knowledge and skill inputs are reduced, while being replaced by external deliveries of such inputs, thereby exploiting external scale economies (Gelaluff et al. 2004). The outsourcing, reflecting external economies of scale for the customers of KIBS suppliers, is one source of productivity enhancing change. An indirect effect obtains from spillovers that are generated by the innovation networks which are created through KIBS activities.

While the role of services for employment growth – especially knowledge intensive ones – is well established, there is a lack of systematic analyses on the role and function of services in innovation (Link and Siegel 2007). Most researchers hold that an accurate model of service innovation is still absent from the literature (Howells 2000). The general argument in the literature is that services adds value by integrating purchased physical technology, which embodies others' R&D and innovation activity, into systems. Thereby, they play an important role in technological change and productivity growth by promoting standards and systems integration. Yet, knowledge of the structure and effects of linkages and transactions networks between knowledge intensive services and other firms in the economy is lacking.

Work Area 4 is outlined to investigate the role of knowledge-intensive business-service suppliers in innovation networks of all type of firms, including manufacturing, household services and business services. This includes a mapping of innovation networks of different business-service sectors in Sweden for a longer time period to corroborate structural changes. Focal questions include: what role has knowledge intensive services firms' innovation processes, do they replace other networks for knowledge flows, and what sectors or markets do they serve? This comprise assessments of service sector firms as actors participating in other firms' innovation efforts, the relationship between innovation efforts and performance amongst service sector firms, investigations of how service inputs affect customer firms' export, import and technical renewal. As work area 3, the current work area will also employ spatial accessibility techniques developed by CESIS to provide insights into the role of proximity for business services networks. This will provide policy-relevant knowledge associated to urban planning and management of location and infrastructure.

Work Area 5: Entrepreneurship and innovation networks

The notion of entrepreneurship is loaded with complex meanings, ranging from finding a source of income when no jobs are available to the drive of individuals' to create novelties, while the strive for temporary entrepreneurial rent remains the centre of entrepreneurial gravitation. However, many researchers emphasize institutional arrangements as an explanation of why the frequency of entrepreneurship varies between different, places, regions and countries.

In view of this, the work area asks: Which features make such structural differences remain invariant between decades, and how can such knowledge be employed in policy. Such analyses can now be carried out with the help of considerably long time series with clear opportunities to investigate dynamic interdependencies. Andersson and Koster (2010) find that spatially sticky and durable determinants of start-ups, which implies that there are sources of persistence to be examined in detail to increase the understanding of how certain functional regions can maintain a start-up rate which is close to double that of the average.

The start of new firms and the introduction of new products (goods and services) to the market is a process which on the micro level reveals a high frequency of entry and exit, whereas the macro pattern normally remains approximately invariant. This context concerns how entrepreneurs discover new business opportunities and how they develop and exploit networks for mobilizing joint innovation efforts. What is the pre-history of new entrepreneurs, and which networks do they carry with them when they leave an employment to start a company (Almeida and Kogut 1999). Relevant networks comprise both links to capital sources and knowledge technology and customer opportunities. Again, new data bases to which CESIS has access will help to illuminate these questions and provide guidelines to innovation network policies.

An recent example of CESIS research in this vein is Andersson, Baltzopoulos and Lööf (2010). Examining entrepreneurial ventures of ex-employees of firms with different R&D strategies three findings not well documented in the previous literature First, firms with persistent R&D investments with a general superiority in sales, exports, productivity, profitability and wages are less likely to generate entrepreneurs than firm with temporary or no R&D investments. Second, start-ups from knowledge intensive business service (KIBS) firms with persistent R&D investments have a significantly increased probability of survival. No corresponding association between the R&D strategies of incumbents and survival of entrepreneurial spawns is found for incumbents in manufacturing sectors. Third, spin-outs from KIBS-firms are more likely to survive if they start in the same firm, indicating the importance of inherited related knowledge. The findings suggest that R&D intensive firms spur fewer entrepreneurs, but their entrepreneurial spawns tend to be of higher quality.

Work area 5 associates to many pertinent policy issues. The most apparent concerns conditions conducive for entrepreneurship in the form of new firms. It also relate to work area 4 (knowledge intensive services) and its policy relevance. The frequency of product introduction and formation of new firms increases in knowledge-intensive service industries and especially knowledge intensive industries and the bulk of new firms is indeed knowledge intensive service firms. Moreover, entrepreneurial knowledge is spatially sticky, embodied in individuals and networks connecting relevant people and thereby tacit in

nature. This suggests that spatial relocation and establishment of new interaction links are important policy measures in the development of sectoral networks.

4. Planned activities to enhance interaction between research and policy

CESIS new activity plan is composed into two parts - one for research activities and a second for interaction with actors in the innovation system and dissemination of results to policy makers.

4.1 Overview of activities to ascertain knowledge exchange

The knowledge exchange strategy shall ensure that the research program results in useful information for the research community, industry and different categories of policy makers at the national and regional level, as well as society at large. This requires that two-way communication is established, and that dissemination is tailored made for target groups.

The CESIS interface with participants in different innovation systems (IS) and policy makers is designed to satisfy the prescriptions in the call, with a clear focus on (i) dissemination of research results to policy makers and (ii) collection of questions from innovation policy-makers and other actors of different innovation systems. To accomplish this CESIS has designed some general policies of dissemination and knowledge exchange, which includes (i) a system for periodical electronic newsletters, (ii) regular presentation of research results for IS policy makers in the form of directed presentations in meetings, (iii) user-specific presentations of innovation diagnostics with regard to sectors (industry groups) and regions, (iv) interpreting what international research results imply in Swedish contexts, (v) producing a "Handbook of Innovation Network Policies".

4.2 Collaboration with other IS actors

The communication strategy will orient and coordinate numerous activities involving stakeholder communication and dissemination of relevant outcomes of the different work areas in order to ensure and facilitate an intense and effective exchange with policy makers, other relevant stakeholders and the wider public.

CESIS' ambition is to continue its already established knowledge exchange with the international research community through channels such as (i) the CESIS working paper series¹⁵ (ii) the annual Uddevalla Symposium which has generated 7 published peer

¹⁵The CESIS WP series has been highly successful since its start in 2004. Currently it contains about 230 working papers (see <http://ideas.repec.org/s/hhs/cesisp.html>) and its popularity has risen over time. Access and

reviewed books during the past ten years, (iii) regular participation in symposia and conferences such as ERSA, WRSA, the Schumpeterian Society and EARIE, (iv) organization of international summer schools on innovation processes, (v) continuing cross-country comparative innovation network and entrepreneurship studies currently comprising the U.S, UK, the Netherlands, Japan, Austria and Germany.

Communication and dissemination objectives of the CESIS application include an ambition to ensure a high level of awareness of CESIS research program in the research, industry and policy communities as well as wider regional and national audiences throughout the life of the research program.

In a Swedish context, CESIS intends to (i) regularly participate in Entreprenörsskapsdagarna, (ii) contribute with presentations at Almedalen, (iii) disseminate findings and conclusions in newspapers and periodicals such as Ekonomisk debatt and Fokus, (iv) organize KTH's innovation days where recent contributions outside and inside CESIS will be discussed. An extension of KTH's innovation days could be the organization of an Elmia's innovation days together with actors such as VINNOVA, the Science Park System of Europe, and others.

Besides these outreach activities CESIS will organize PhD courses on innovation systems analysis and establish a close collaboration with KTH Innovation and Jönköping's Science Park. CESIS also intends to build on its experiences of collaboration with AstraZeneca during the last two years and establish additional such company contacts.

4.3 Design of a knowledge exchange strategy

The knowledge exchange strategy shall ensure two-way communication with policy makers and other relevant stakeholder groups as parts of a collaborative knowledge generation and learning. Key steps for communication and dissemination are enumerated below:

- Preparation of a communication and dissemination plan vis-à-vis all target groups including industry and government at the regional and national level to encourage also creative inputs to the research processes from relevant stakeholders. This will enrich the credibility of the research, engage key players such as VINNOVA and provide the commitment to ensure that the research program will get a high visibility among innovation policy makers. The purpose of this plan is to define key target audiences and decide the appropriate modes of communication.

download statistics can be found at <http://logec.repec.org/scripts/seriesstat.pf?item=repec:hhs:cesisp>. The series contain contributions by CESIS researchers in Sweden as well as collaborators such as Zoltan Acs, David Audretsch, Richard Florida, Bo Carlsson, Almas Heshmati, to name a few.

- Capitalization on a portfolio of communication vehicles including the production of a range of mechanisms to disseminate the research such as an open, accessible Website (with both internal features for the researchers involved and external features for external stakeholders), a newsletter (to be delivered electronically on a quarterly basis), a range of publications including “Key Findings” to alert VINNOVA and other stakeholders throughout the life of the research program. All reports should be made accessible through CESIS’s webpage (www.cesis.se).
- National, regional and sectoral communication and dissemination via the involvement of policy makers and other stakeholders in national, regional and sectoral initiatives including national and regional expert meetings to present and discuss the research results including innovation policy recommendations for the EU, the national and the regional level as well as presentations at seminars, conferences and other public events.
- Formal meetings yearly with VINNOVA and major national and regional stakeholders in research, industry and innovation policy.
- Development of a media strategy and the initiation of a process of communication with media to build an interest in the research results throughout the life of the program and to find ways to communicate relevant information and knowledge to “stay in the news” at both the national and regional level including articles in newspapers and professional journals, and interviews in newspapers, TV, and radio.
- Academic Outreach: The researchers engaged in the program have well developed international research networks and the ambition is to capitalize on the research results to spawn joint follow-on research studies in a number of areas. In addition, we will produce working papers, journal articles, and books for the international academic audience, present the research results at international research conferences and organize our own international research workshops, conferences and symposia, such as the Uddevalla symposium. We also intend to organize PhD courses and summer university courses focusing innovation, sustainable growth and innovation policies. At the end of each of the two periods, we plan to organize a major international research conference.

4.4 CESIS Partners

Swedish partners in the CESIS efforts include agencies and boards with which the centre can join forces in both research tasks and in dissemination and other outreach activities. CESIS will also invite representatives from some of the partners below to participate in CESIS’ national board. The rationale for having partners is that they are key organizations for (i)

direct communication of research results, (ii) discussion when selecting firms and other information network actors to be interviewed in particular work packages, (iii) audience panel for diagnostic reports, and (iv) supporters in the process of finding resources in user-specific projects. National and sectoral partners are:

- Growth Analysis Agency (Tillväxtanalys)
- Swedish Agency for Economic and Regional Growth (Tillväxtverket)
- Forum for Reforms, Entrepreneurship and Sustainability (FORES)
- IVA via its Globalization Council
- Svenskt Näringsliv
- Swedish Board of Agriculture (Jordbruksverket)
- Swedish Trade Council (Exportrådet)
- Swedish association of local authorities and regions (SKL)
- Swedfund
- The National Board of Housing, Building and Planning (Boverket)
- Science Parks of Europe

Regional and local partners are:

- KTH Innovation
- Innovation Platform
- Jönköping Science Park
- Regional industrial policy makers (municipalities, Skåne region, Västra Götaland region, RUP-activities in County Administrations)
- Business Region Göteborg AB
- Business Region Stockholm
- Öresund consortia, e.g. IBU

5. Activity plan

5.1. Project Team, Networks, Data Sources and Budget

5.1.1 Project team and key persons of the organization

The project team described below is designed for the first 3 years of the program but is assumed to retain most of its members also into the second period. The team include people from three different scientific disciplines: (i) economics, (ii) statistics and (iii)

business administration (entrepreneurship). A majority of the team are employed at KTH (Royal Institute of Technology) or JIBS (Jönköping International Business School) or both. The core persons of the team are typed in bold letters. Associate professor M. Andersson has been CESIS' research coordinator for the past five years. Professor B Johansson has been director of CESIS since its start, and like M. Andersson he will share time in research and policy interaction with double affiliation at KTH and JIBS. Professor Hans Lööf was one of the initiators that formulated the research profile of the first 6 years of CESIS research. Anders Broström and Kristina Nyström both finalized their respective PhD theses as CESIS researchers. They will both take an active part in the program's dissemination activities. Pontus Braunerhjelm is professor of International Business, Innovation and Entrepreneurship. Associate Professor Johan Klaesson is director of RUREG (Research Unit for Rural Entrepreneurship and Growth) at JIBS. CISEG-participants in CESIS program include Hans Westlund and Friedrike Welter, both Professors of Entrepreneurship. Ghazi Shukur is professor of statistics with significant knowledge of wavelet analysis.

<i>Name</i>	<i>Initials</i>	<i>Age</i>	<i>Gender</i>	<i>Title</i>	<i>Fraction</i>	<i>Affiliation</i>
Martin Andersson*	MA	33	Male	Assoc. prof.	100 %	KTH, JIBS
Börje Johansson*	BJ	65	Male	Prof.	50-60 %	KTH, JIBS
Hans Lööf*	HL	54	Male	Prof.	50 %	KTH
Anders Broström*	AB	33	Male	Ph.d.	50 -60 %	KTH
Kristina Nyström*	KN	36	Female	Assist. prof.	25 %	KTH
Pontus Braunerhjelm*	PB	58	Male	Prof.	15 %	KTH
Charlie Karlsson*	CK	65	Male	Prof.	20 %	JIBS, BTH
Ghazi Shukur*	GS	55	Male	Prof.	20 %	JIBS
Johan Klaesson*	JK	43	Male	Assoc. prof.	50 %	JIBS
Andreas Stephan	AS	42	Male	Prof.	15 %	JIBS
Sara Johansson	SJ	35	Female	Ph.d.	30 %	JIBS, SJV
Johan Eklund	JE	33	Male	Ph.d.	35 %	JIBS, RATIO
Lars Pettersson	LP	43	Male	Ph.d.	25 %	JIBS, SJV
Friedrike Welter	FW	48	Female	Prof.	25 %	JIBS
Charlotta Mellander	CM	39	Female	Assoc. prof	25 %	JIBS, Toronto
Per Thulin	PT	45	Male	Ph.d.	25 %	KTH
Hans Westlund	HW	53	Male	Prof.	20 %	JIBS, KTH
Stefan Fölster	SF	47	Male	Prof.	10 %	KTH
Enrico Deiacio	ED	53	Male	Econ. lic.	10 %	KTH
Research assistants 1-2	RA				100 %	JIBS
PhD students 6-7	PS				50 %	JIBS, KTH

5.1.2 International Research Network and Core Collaborators¹⁶

The current network of CESIS for international collaboration comprises the following nodes: (SN1) UNIMAS, Maastricht, Netherlands, (SN2) ZEW, Mannheim, Germany, (SN3) GMU¹⁷, Washington, USA, (SN4), Hitosubashi University, Tokyo, Japan, (SN5) Dipartimento di

¹⁶ Besides a national board, CESIS will form a board of international advisors from in network of international advisors.

Economia (Department of Economics) Università degli Studi di Torino, Italy, (SN6) Copenhagen Business School, Denmark, (SN7) Leuphana University of Lueneburg, Lueneburg, Germany, (SN8) Bocconi University, Milano, Italy, (SN9) Liverpool university, UK, (SN10) Indiana University, Bloomington, US, (SN12) DIW Berlin, German Institute for Economic Research, Germany, (SN13) Department of Economics, Boston College, US, (SN14) Case Western Reserve University, US, (SN15) Centre de Recherche en Économie et Statistique CREST Institut National de la Statistique et des Études Économiques INSEE, (SN16) Faculty of Economics and Business Administration Tartu Ülikool, Estonia, (SN17) Korea University, Seoul, Korea, (SN18) Institute for Financial Research (SIFR), Stockholm, Sweden (SN19) University West and BTH, Sweden and (SN20), University of Groningen, Netherlands, Georgia Institute of Technology, Department of Economics, USA (SN21), Magyar Tudományos Akadémia (Hungarian Academy of Sciences), Hungary (SN22).

These nodes contains researchers with which CESIS is currently or has set up plans for research interaction. Some of these researchers are listed in the following table, where core collaborators (involved in many projects) are marked with bold type.

SN1	Bart Verspagen (BV), Pierre Mohnen (PM) and Luc Soute (LS), UNIMAS, Maastricht
SN2	Bettina Peters (BP), Christian Rammer (CR), Georg Licht (GL), ZEW, Mannheim
SN3	Zoltan Acs (ZA), Roger Stough, (RS), David Hart (DH), Christopher Hill (DH), Kingsley Heynes (KH)
SN4	Yukinobu Kitamura (YK)
SN5	Christiano Antonelli (CA), Ando Geuna (AG)
SN6	Keld Laursen (KL), Ari Kooko (AK), Jens Gammelgard (JK)
SN7	Joachim Wagner
SN8	Francesco Lissoni (FL)
SN9	Gary Cook (GC)
SN10	David Audretsch (DA)
SN12	Dorothea Schäfer (DS), Anna Lejpras (AL)
SN13	Christopher Baum (CB)
SN14	Bo Carlsson (BC)
SN15	Jacques Mairesse (JM)
SN16	Jaan Masso (JMA), Priit Vahter (PV)
SN17	Almas Heshmati (AH)
SN18	Per strömberg (PS), Gustav Martinsson(GM)
SN19	Urban Gråsjö (UG)
SN20	Philip McCann (PM), Siedjan Koster (SD)
SN21	Vivek Ghosal (VG)
SN22	László Halpern (LH) and Balázs Muraközy (BM)

¹⁷CESIS has especially well-developed collaboration with GMU. First, CESIS has signed a formal agreement on collaboration in innovation and entrepreneurship research. Second, a joint double degree between JIBS and GMU is under preparation, focusing on the economics and policy of innovation.

5.1.3 Data sources

Since its inception in 2004, CESIS has developed and secured access to a large body of data designed for empirical innovation analyses at various levels, including firms, sectors, regions and economy-wide. These data include balance-sheet information of firms over time, a sequence of community of innovation surveys (CIS) at the firm-level, ownership data, firm-level data on international trade tabulated on products and destination countries, patents and R&D investments, as well as matched employer-employee data. The data comprise an important asset, not the least since identification numbers of firms are the same in the different data sets, such that CESIS researchers are able to match e.g. CIS data with international trade, balance-sheets and the matched employer-employee data.

The table below presents the different data materials CESIS has developed and secured access to. These data will be used in the different work areas. It should also be stated that the collaboration with researchers in other countries is such that CESIS databases can be matched with those of the collaborators, such that comparisons are made possible. Moreover, as stated in the application text, CESIS will complement the analyses based on register and CIS-survey data with interviews of selected firms and other IS-actors to put the results in perspective and test alternative interpretations of results. CESIS' report on the role of AstraZeneca in Sweden's knowledge economy is a good example.¹⁸

DS 1	Register data on general economic characteristics of all firms in Sweden 1987-2008
DS 2	Register data on financial variables for of all firms in Sweden 1987-2008
DS 3	Educational data for all firms in Sweden 1987-2008
DS 4	Ownership data for all firms in Sweden 1987-2008
DS 5	Exports and imports at the 8-digit product code at the firm level, and country of origin of imports and country of destination of exports
DS 6	Place of location for all firms in Sweden
DS 7	R&D data for all firms in Sweden with 50 or more employees 1987-2003 (bi-annual)
DS 8	R&D data for all firms in Sweden with 200 or more employees 1987-2007 (bi-annual)
DS 9	Community Innovation Surveys: 1996, 2000, 2004, 2006 and 2004
DS 10	National innovation survey 1998
DS 11	Statistics on trade in services, Swedish companies 2000-2008
DS 12	Age of all firms in Sweden, 1987-2008
DS 13	Educational data for all individuals in Sweden 1987-2008
DS 14	Intra-firm trade, domestically and globally 1987-2008
DS 15	Patent data domestically and globally for all firms in Sweden 1987-2008, PATSTAT
DS 16	Compustat data for Sweden and for selected comparative countries 1995-2008
DS 17	Comparative statistics for comparison countries
DS 18	Venture capital database, Sweden
DS19	FAD, Företagens arbetsställe demografi

¹⁸CESIS WP 154 titled *Multinationals in the knowledge economy – a case study of AstraZeneca in Sweden* (<http://ideas.repec.org/p/hhs/cesisp/0154.html>).

5.1.4 Budget

The budget contains two major components, separated for (i) dissemination activities and support, and (ii) work area allocation. The time profile of individual work areas is influenced by already committed (and financed) research. Work area costs include overhead, which is charged differently at KTH and JIBS. In the latter case overhead is calculated as 27 percent of wage costs.

	2010-11	2011-12	2012-13	2013-15
Dissemination and contact with partner	450	300	300	800
Research coordination, Working-paper series	150	180	180	360
Conferences and exchange across work areas	80	120	100	200
Administration services	60	60	60	120
Work Area 1	1 800	2 000	2 000	3 000
Work Area 2	1 200	1 400	1 400	3 500
Work Area 3	1 200	1 000	800	2 000
Work Area 4	800	1 000	1 000	2 000
Work Area 5	800	800	1 000	2 500
Work Area 6	-	-	200	2 000
Sum, including overhead cost	6 540	6 860	7 040	16 480
Across area data and dissemination reserve	1 360	1 040	1 060	1 020
Budget according to planned financing	7 900	7 900	8 100	17 500

5.2 Activities 2010-2013

The following three Gantt charts outline activities to be undertaken during the first period of the program period. The chart focuses on listing dissemination activities and their allocation in time. Note research within the five work areas will be undertaken continuously as described in the budget table.

Task	2010						2011										
	July	August	September	October	November	December	January	February	March	April	May	June	July	August	September	October	
Development of web-based interaction platform	[Bar from July to December]																
Launch of CESIS web-based interaction platform with presentation at VINNOVA						[Bar in December]											
Preparation of CESIS seminar at the "Småföretagsdagarna" 2011				[Bar from October to February]													
Establishment of CESIS new international advisory board	[Bar from July to September]																
Establishment of CESIS national advisory board	[Bar from July to September]																
Preparation of Uddevalla Symposium 2011 with CESIS special sessions				[Bar from October to May]													
Preparation of "innovation days" at KTH and Jönköping Science Park				[Bar from October to April]													
Article on innovation and exports in Sweden in "Ekonomisk debatt"						[Bar from January to May]											
Debate article on innovation and exports in Sweden in major Swedish newspaper (DI, SvD, DN)											[Bar in June]						
Article on R&D investments and productivity among Swedish firms in "Ekonomisk debatt"											[Bar from June to August]						
Debate article on R&D and productivity among Swedish firms in Sweden in major Swedish newspaper (DI, SvD, DN)																[Bar in September]	

5.3 Activities 2013-2015

The dissemination activities during the second period of the CESIS program will of course depend on the research orientation in this second period. This means that activity plan for the last two years has to be associated with a research program outline. However, the research in the areas WA.1 on Dynamics of Innovation Efforts, WA.2 on Export Performance and Innovation Networks, WA.3 on Knowledge Flow Networks, WA.4 on Knowledge-Intensive Services, and WA.5 on Entrepreneurship and Innovation Networks will allow the program to present Regional Innovation Diagnostics, which will illuminate problem areas and policy opportunities for a set of regions. Such diagnostics should include one for the Stockholm region, the Göteborg region with Västra Götaland and the Malmö region with Skåne and Blekinge. It should also comprise overall diagnostics for typical medium-sized regions as well as small and peripheral regions. In addition, the program is designed to include a special diagnostics for rural areas. Each of these diagnostics should be presented for pertinent decision makers in each region as well as for a broader audience.

The table below outlines a broad description of the planned research in the different work areas the second period.

WA1 Dynamics of firms' innovation efforts	Organize the results from period 1 into components of a firms strategic behavior which can be influenced by Swedish and European policies. Further employ Wavelet and other techniques for long enough time series – using data from other countries, and to compare firms' innovation strategies across countries in EU and in US. The comparison activity should be approached in such a way that policy conclusions become more obvious. Interviews will be conducted. Stronger focus on the special behavior of firms which belong to multinational groups (MNE-firms), where a fundamental aspect is a group's choice of location with regard to R&D, commercial and production sites.
WA.2 Export performance and innovation networks	Swedish firms are more active in export activities than firms in other European countries. In the second period of the program the research is oriented to examine specific network advantages that are present for MNE-firms. The relevant question is then: can policy compensate non-MNE-firms for their network disadvantages? This question is asked in the context of sectoral innovation systems.
WA.3 Knowledge flow networks	Accumulated findings in this area will allow dissemination about knowledge exchange and diffusion in the perspective of local flows (inside functional regions) and global flows across borders of functional regions and countries.
WA.4 Knowledge intensive business services in innovation networks	During the second period the expansion of business services will be presented as a fundamental transformation of the Swedish (and the global) economy. This transformation is especially fast in larger urban regions. Thus, the associated policy discussion will be an important part of CESIS' regional diagnostics.
WA.5 Entrepreneurship and innovation networks	The nexus of entrepreneurship and networks will also be an important part of the regional diagnostics during the second period.
WA.6 Sectoral innovation systems	During the second period the CESIS program will include a new element for a more complete assessment of the notion of sectoral innovation networks and of the associated policy opportunities.

6. Financial structure

The co-financing of CESIS program research on sectoral innovation systems, contains two major sources. The first comprises economic resources which have allocated to accounts with means to pay wages to researchers for participating in the program. Such means have been decided upon at JIBS and KTH. This type of allocation of program funding also includes wage sums that shall cover research time (not study time) for PhD students. There will be 4-5 such students at JIBS and 2-3 at KTH. The second source for financing research consists of resources brought into the program from collaborators in joint efforts. Such collaborators include SJV (Swedish Board of Agriculture), CISEG and RUREG at JIBS and SSE.

	2010-2011	2011-2012	2012-2013	2013-2016
Wage accounts for PhD CESIS-research at JIBS	800 kkr	800 kkr	1000 kkr	2 000 kkr
Wage accounts for PhD CESIS-research at KTH	400 kkr	400 kkr	400 kkr	1 500 kkr
Accounts at JIBS for CESIS-research, coordination and management*	1 400 kkr	1 400 kkr	1 400 kkr	3 000 kkr
CISEG and RUREG contributions at JIBS**	200 kkr	200 kkr	200 kkr	500 kkr
Resources for joint projects with SJV (research assistants and data)***	200 kkr	200 kkr	200 kkr	500 kkr
Network resources for collaboration between SSE, KTH and SU****	200 kkr	200 kkr	200 kkr	600 kkr
Wage accounts at JIBS for research fellows from SJV	300 kkr	300 kkr	300 kkr	600 kkr
External funding and KTH support to CESIS*****	1 000 kkr	1 000 kkr	1 000 kkr	2 000 kkr
Uddevalla Symposium, University West, VA Götaland and other stakeholders	200	200	200	400
Annual applications for the Uddevalla Symposium	200	200	200	400
Sum	4 900 kkr	4 900 kkr	5 100 kkr	11 500 kkr
Other expected funding, partly associated with partners	1 500 kkr	1 500 kkr	1 500 kkr	3 000 kkr