5. IST Research in Sweden

In 1993, Sweden spent a total of 48 billion SEK, the equivalent of 3.3% of the GNP, on research and development. 69% of the total research was carried out within the industry area, and 22% by academic institutions. 9% was carried out by the public sector. But the public sector paid for more than 80% of all R&D carried out at the academic institutions, and over 10% of the industrial research.

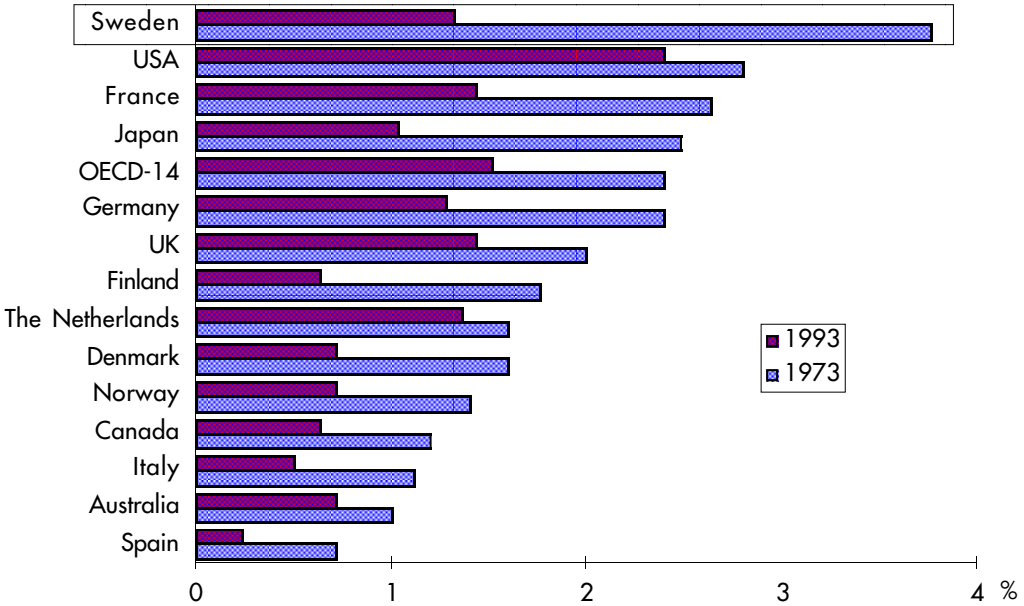
Costs for IST research for 1993 were almost 12 billion SEK for the industry related research, and some 450 million SEK for the academic research programs. The sum is equivalent to one fourth of the total money spent on R&D in Sweden.

Four industries belong to IST — office equipment, computers, telecommunications equipment, and electronic instruments, according to Statistics Sweden.

Over the past few years a closer relationship between industry and academia has resulted in a number of new research programs in the telecommunications and IT fields throughout Sweden. In many cases, local universities are heading research programs in direct collaboration with industry. This chapter gives an overview of IST related activities in Sweden.

Sweden World Leader in Research in 1993

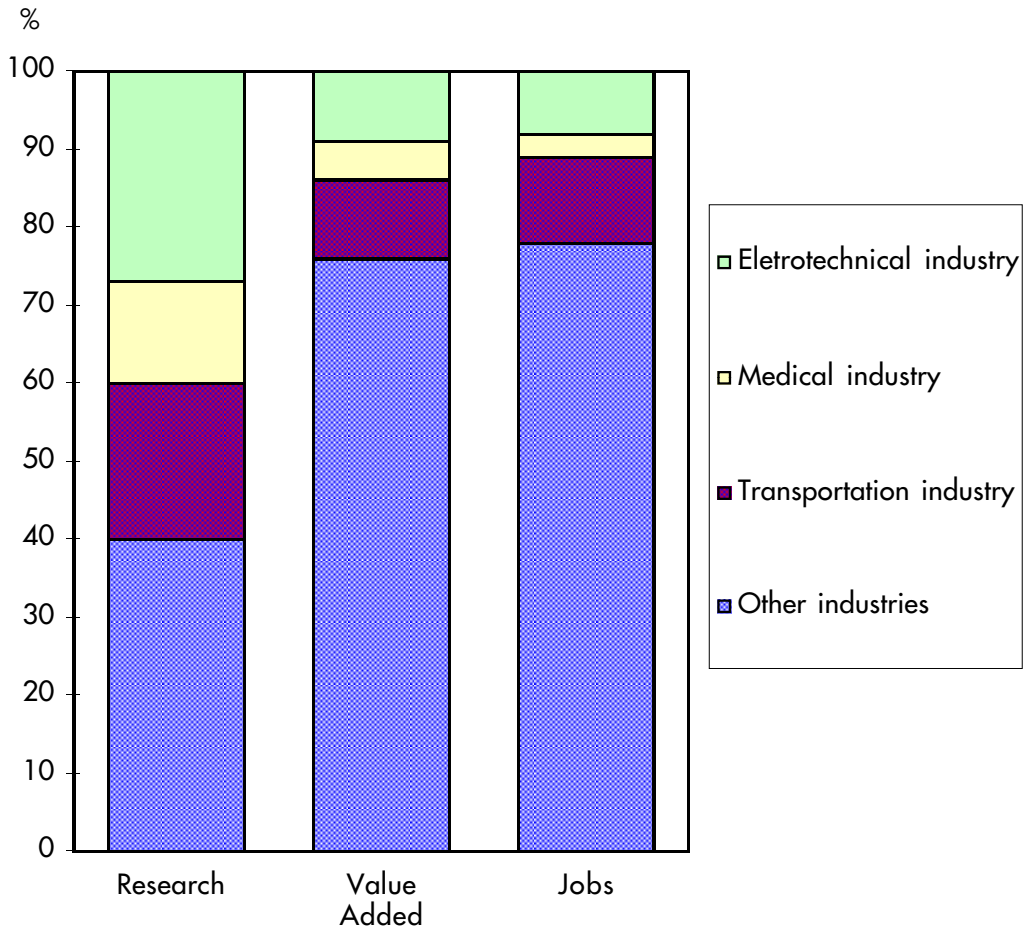
Part of the total production, in percent, for 1973 and 1993



(Diagram 4:A:1): According to the OECD report "Science,Technology and Industrial Outlook 1996", Sweden is leading the research and development league when it comes to percentage of spending related to total production, 4% in 1993, compared to 1% twenty years ago.These are the good news. The bad news are that it is a handful of Swedish companies with international markets, that are responsible for the larger part of the research. 27% of the total research money in Sweden is spent in the electrotechnical area, including companies like Ericsson and ABB where telecommunications and IT belongs. 13% is spent in the medical field, another important Swedish export industry, 20% in the transportation industry, and the remaining 40% in other industries.
Sources: OECD/Ny teknik 1996:46

Research, Value Added, and Jobs Distributed per Industry in Sweden in 1996

In percent of the total industrial value



(Diagram 4:A:2): Telecommunications products are expensive to develop. About one fourth of the total industrial Swedish research is spent in this area. Volvo, Scania, and Saab are spending some 20% of the total research money, and the medical industry, including Astra and Pharmacia Upjohn, spends 13%. But the most research intense companies are not creating the largest value added and the most jobs. In these areas,the other industries are about twice as successful as the research heavy industries.

Sources: Ny teknik 1996:46/Statistics Sweden

Share of Office, Computing, and Accounting Machinery in Manufacturing for the Period 1980 to 1992

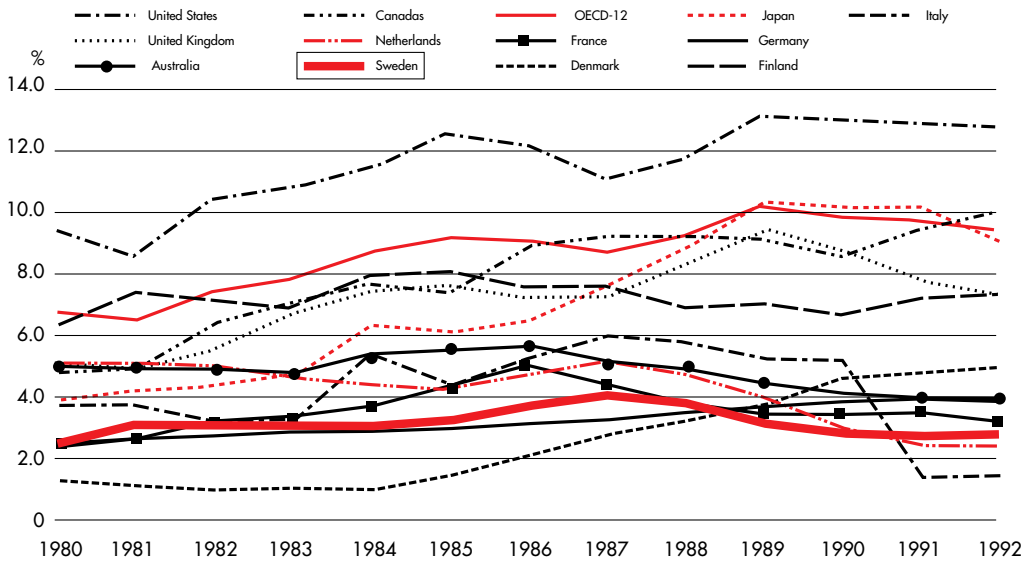


Fig. 25 Feb 2: The United States devotes by far the largest share of its BERD (BERD = Business Enterprise Expenditure on R&D) to office, computing and accounting machinery, the OCA sector, about 13%. This sector is among the largest manufacturing sectors in terms of R&D intensity. Sweden, together with France, Denmark, Finland, and Japan are decreasing their share in the OCA R&D.

Sources: STAN database (DSTI, EAS Division)/OECD: Information Technology Outlook 1995, ©OECD, reproduced with the permission of the OECD

Evolution of Relative Technical Specialisation 1975 — 1993
In percent per country/region

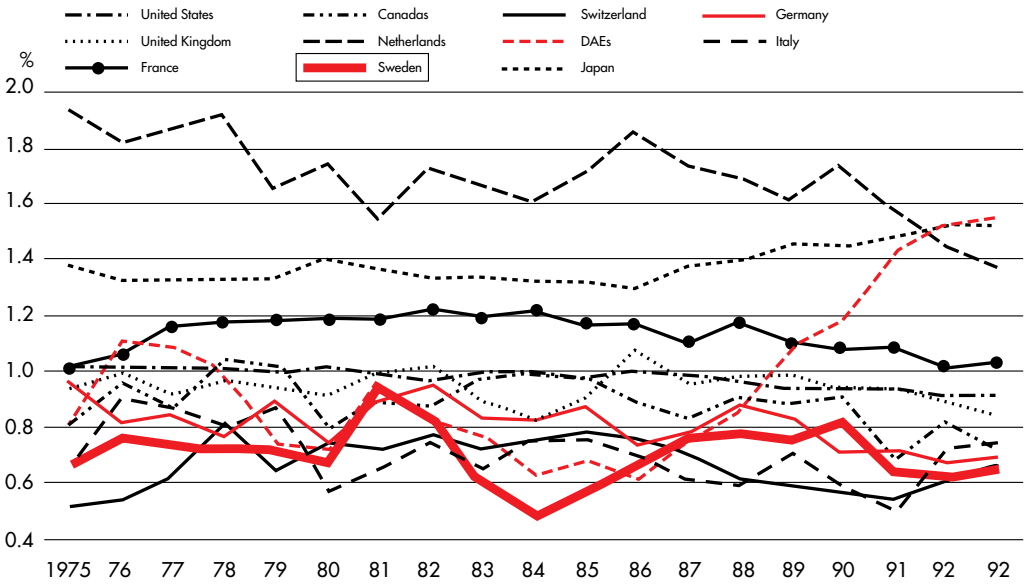


Fig. 25 Feb 5: Relative specialisation is measured by the country's share in patents filed in a given field in a given system, as a ratio of its share of all patents in that system. The diagram shows the evolution of the IT specialisation from 1997 to 1993 in percent of total patents filed.

Sources: CHI Research, Inc./OECD:Information Technology Outlook 1995, ©OECD, reproduced with the permission of the OECD

Business Enterprise R&D Intensity 1980 and 1991

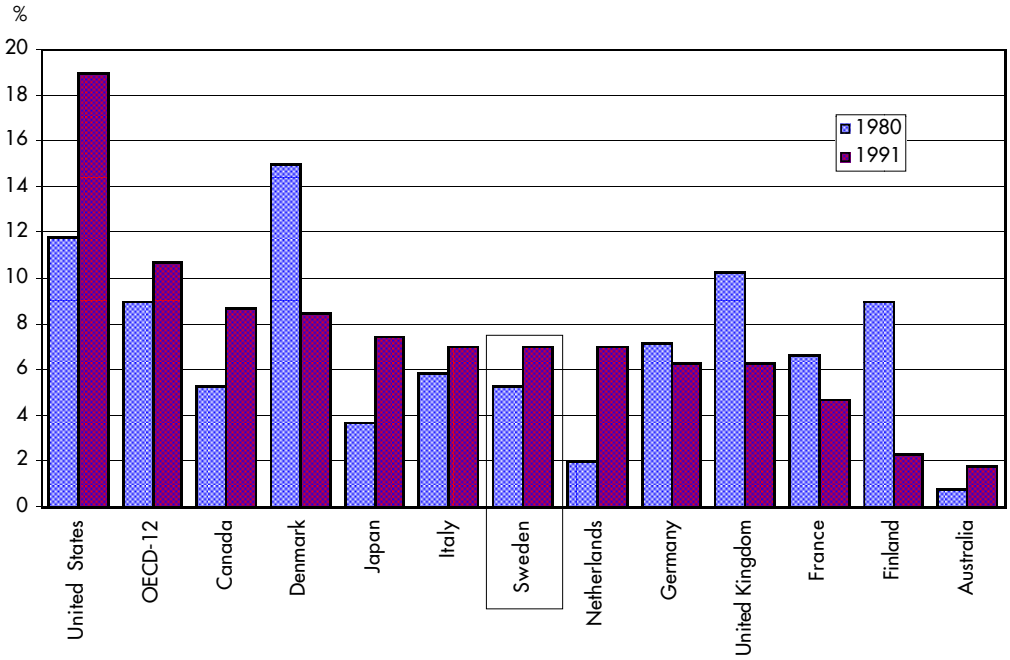


Fig. 25 Feb 3: The diagram shows the business enterprise R&D intensity in the OCA sector for 1980 and 1991 for selected OECD countries and the OECD-12 compound, in percent.

Sources: STAN database (DSTI, EAS Division)/OECD: Information Technology Outlook 1995,

Patents Granted in USA in the IT Field for Selected Countries and Regions 1975 — 1993
Percentage of world total

	1975	1980	1985	1990	1993
Europe	19.5	19.7	19.9	16.6	12.9
EU	18.3	18.2	18.6	15.8	12.1
France	3.3	4.0	3.9	3.4	2.9
Germany	7.1	6.4	7.3	5.5	4.2
Italy	0.7	0.8	0.7	1.0	0.7
Sweden	0.8	0.7	0.8	0.5	0.4
UK	4.0	3.6	3.2	2.9	1.9
EFTA	1.2	1.5	1.3	0.8	0.8
Switzerland	1.1	1.4	1.2	0.8	0.7
North America	66.9	62.3	55.5	50.3	51.1
Canada	1.4	1.3	1.6	1.6	1.3
United States	65.6	61.0	53.9	48.7	49.8
Japan	12.2	16.1	23.3	30.7	32.0
OECD	98.8	98.4	99.0	97.9	96.3
DAE	0.1	0.1	0.2	1.3	3.2
Total	100.0	100.0	100.0	100.0	100.0
Number of patents	10 135	9 056	12 140	16 965	19 259

Fig. 25 Feb 4: International comparisons relating to information and communication technology involve the use of patent data. Patent applications are filed with the European Patent Office, EPO, or the US Patent Office, USPTO. Figures per industry as the ones used in this table, are only available from the USPTO.

Sources: CHI Research, Inc./OECD: Information Technology Outlook 1995, ©OECD, reproduced with the permission of the OECD

Patents Granted in USA in the IT Field by Country of Origin 1975 — 1993
In percent of total, United States excluded

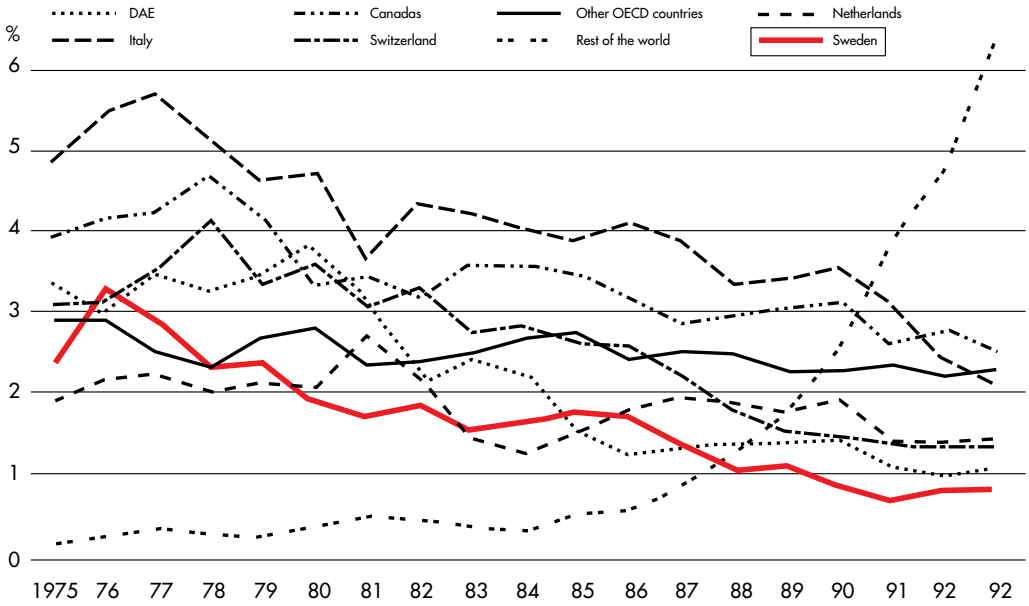


Fig. 25 Feb. 13: 63% of all IT patents generated by non-Americans in the US are granted to Japanese companies. Germany is the second largest, getting 9% IT patents granted, followed by France, with 7%, and the UK with some 4%. These countries are not shown in the diagram. Among the countries shown, it is remarkable to note the rapid growth in patents for the DAE countries, while all others are declining. Now, this diagram shows the percentage of the total IT patents granted to foreign companies in the US. It should be kept in mind that the total number of patents have increased considerably. See the preceeding diagram.

Sources: CHI Research, Inc./OECD: Information Technology Outlook 1995, ©OECD, reproduced with the permission of the OECD

5.1. Swedish IST Research Institutions

5.1.1. Academic Research Institutions

According to Statistics Sweden, the following institutions are involved in ICT research programs in Sweden:

* Stockholms universitet — The University of Stockholm
* Karolinska institutet — The Karolinska Institute
* Kungliga Tekniska Högskolan i Stockholm — The Royal Institute of Technology at Stockholm
* Uppsala universitet — The University of Uppsala
* Linköpings universitet — The University of Linköping
* Lunds universitet — The University of Lund
* Göteborgs universitet — The University of Gothenburg
* Chalmers tekniska högskola — The Chalmers Insitute of Technology at Gothenburg
* Umeå universitet — The University of Umeå
* Universitetet i Luleå — The University of Luleå
* Högskolan i Karlskrona/Ronneby — The University College of Karlskrona/Ronneby
* Högskolan i Karlstad — The University College of Karlstad
* Mälardalens högskola — The University College of Mälardalen
* Högskolan i Skövde — The University College of Skövde
* Mitthögskolan — The University College of Sundsvall/Härnösand

The majority of the separate institutions involved belong to the faculty of technology; some IST research are carried out at the faculties for economics and social sciences; one medical institution is involved in IST research. No IST research is carried out at any humanistic institution in Sweden.

Five universities, those of Gothenburg, Luleå, Lund, Stockholm, and Uppsala carry out IST research at the institutions of social sciences.
Two universities have created what is described as new cross scientific institutions, dedicating themselves to IST research. At the university of Umeå, there is an institution called "The media and data didactic centre". At the university of Uppsala, there is a "Centre for man/computer".

At the university of Lund, there is a cross scientific research program going on regarding the information technology user, but all institutions participating belong to the faculties of social and economic sciences.

At the University of Linköping, there is a specific research program called "Tema T — Man, Society, and IT", where a number of interesting research projects on the interaction of humans with technology is carried out.

5.1.2. Selected Current Academic Research Projects

* Several advanced IC technological research programs are running at for instance:
  - The Chalmers Institute of Technology
  - The University College of Karlskrona/Ronneby
  - The Royal Institute of Technology
  - The University of Linköping
  - The University of Luleå
  - The University of Lund
  - The University College of Middle Sweden (Sundsvall/Härnösand)
  - The University College of Mälardalen (Västerås/Eskilstuna)

* User research program at the University of Lund: A cross scientific user research program, covering personal telephony seen from the following aspects
  - micro economics
  - social anthropological
  - media and communication science related aspects
  - telecommunications traffic systems
  - applied electronics

  So far, this is the most extensive research program of its kind in Sweden. Several reports have been published.

* Teleeconomic research programs are carried out by several institutes, such as:
  - IUI, Industrins Utredningsinstitut, The Industrial Research Institute, involved in several programs
  - EFI, Ekonomiska Forskningsinstitutet, The Institute for Economic Research looking into "telecommunications in the information society"
  - The Stockholm School of Economics, running several programs
  - The Institution for Microeconomics at the University of Stockholm, studying "teleeconomics and telecommunications utilisation"
  - The Institute for Economic Research at the University of Lund — see above.
  - IMIT, studying "the growth of telecommunications"
  - The Institute of Technology at the University of Linköping, running a program called "IT for humans and corporations"
  - The University of Linköping through its program "Tema T" is looking into various aspects on the interface between humans and technical systems
  - The University of Umeå is carrying out a pilot program called "utility creation by tele and data communication"

* Informatics for medical applications and learning is studied at the Karolinska Institute in Stockholm

5.1.3. Industry Related Research Institutions

The following are some of the leading industry related research institutions and their major research programs:

* ABB Research — software processes
* CDT, Centrum för Distansöverbyggande Teknik, Luleå — a development center for advanced signal treatment
* SICS, The Swedish Institute of Computer Science — Computer science
* SISU, The Swedish Institute for System Development — Internet technology
* Telia Research — Net solutions for telecommunications and telecommunications applications

*** New National IST Research Institute by July 1997**

Institutet för tillämpad informationsteknik, (The Institute for Applied Information Technology) is to be created by July 1, 1997. This is to be a national research institute, which will replace SICS, The Swedish Insitute for Computer Science; The Institute for Media Technology (Institutet för Medietekink); and SISU, The Swedish Institute for Systems Development (Svenska institutet för systemutveckling). The Foundation for the Development of Knowledge and Competence (Stiftelsen för kunskaps- och kompetensutveckling) is the funding organisation of the new research institute, which will absorb the researchers as well as the research programs of the present institutes.

Sources: Several, among them Computer Sweden, 7 March 1997

5.2. Swedish Participation in International Research Programs

So far, Sweden has participated in several international research programs. For instance:

- The EU COST Telecommunications Programme, among the COST projects in:
    * COST A4, 1992 — 1995: Social Shaping and Technology: Telematics in rural development, inter-organizational IT networks, EDI, domestic shaping of information technology, through MITS, The University of Linköping;
    * COST A5 1991 — 1994: Ageing and Technology: Work and ageing, health indicators, social integration, through MITS, The University of Linköping;
    * COST 14: Cooperation Technology, CSCW;
    * COST 248: The Future European Telecommunications User — Understanding for the Implementation of a European Research Action on the Future European Telecommunications User, through the University of Lund.

The background of COST 248, just as an example of a user research program, is described as follows by the Eurocrats:

"Poorly predicted and poorly understood changes in the residential user's demand for telecom services could undermine the long-term viability of many PTOs. Such changes in demnad could be triggered by new ways of living, new patterns of working, new tastes, and a new way of looking at telecom services.

... relatively little effort is made to focus on the ordinary consumer and user of telecom services. There is a strong need for research that improves our knowledge of his or her experience and perception of current and future telecom services.

The ultimate judge of a service is the end-user. Studies of the development of new technologies show that the involvement from the users may be a valuable source of knowledge for the development process. Compared to the commercial customer, the residential user has few channels of influence.

...But the business user has already been extensively studied while knowledge about the residential user is sadly lacking."

The following nations participate:
Denmark, France, Ireland, Croatia, the Netherlands, Norway, Switzerland, Slovenia, UK, Sweden, Germany, and Hungary.

A final report will be presented during 1997.

* The RACE project for 1994 —1998, in particular the ACTS project, ACTS standing for Advanced Technology Communication and Service. ACTS is made up by six sub projects:
  - multimedia
  - photonics
  - high speed communication networks
  - mobility and personal communications
  - intelligent networks
  - network security

* RESOLUTIONS, Re-use of Solutions, is a pilot project in the EU, described as follows:
  "Technical developments will be limited to exploit existing telematic technology for creating a cross-border demonstrator, featuring a multilingual multimedia distributed knowledge base that will both give access to information and services related to city life and describe some general administrative best-practice solutions to common practical problems...

... Presumably, the critical part of the project will not be related to the technology ... but it will reside on the problems of datasharing and of modification, harmonisation and standardisation of international procedures...

... The creation of a multi-language data-base would allow a transparency of public documents and of decisions procedures and therefore a deeper involvement of citizens into public life; hopefully, being able to examine in depth public facts and public affairs, citizens will stop showing laziness, time constraints, unwillingness and indifference towards problems of social interest. In addition, thanks to the proposed information system, they could also express their own opinions on specific problems so deeply felt in every life, and thus suggest new ways of problem solving or new technological requirements."

The City of Stockholm is participating together with Rome in working out how the democratic processes can be improved. Swedish members of the consortium are: The University of Stockholm - The Institution for learning; Enator AB; The communities of Botkyrka and Nacka.

Nordic Participation in EUREKA Projects* 1985 — 1995
Per Technology Area

Research area	Denmark Million ECUs	Finland Million ECUs	Iceland Million ECUs	Norway Million ECUs	Sweden Million ECUs
Medical and biotechnology	62.6	122.3	0.7	50.6	63.1
Communications	250.6	257.9	0	44.1	15.2
Energy	7.8	35.1	0.8	12.6	42.6
Environment	277.4	146.6	7	234.8	271.1
ICT	184.9	240.8	8.2	232.0	163.4
Laser technology	90.1	41.1	0	47.2	19.4
New materials	17.4	16.7	0.9	15.2	26.7
Automation	87.1	31.8	6.0	9.2	55.7
Transports	10.1	18.2	0	19.1	61.2

Fig. 24 april 1: The table shows the participation of the Nordic countries in various EUREKA projects during 1985 — 1995, in million ECUs, per technology area. The Nordic countries are important research parthers to each others: Denmark has Nordic participation in 50% of all research projects; Finland 52%; Iceland 67%; Norway 60%, and Sweden 53%.

Source: NORDForskning: Vitenskaps- og teknologiindikatorer for Norden 1996 (Science and Technology Indicators for the Nordic Countries)

5.3. Swedish IST Research and Development Programs

* The ITYPE-program, Informationsteknologi för yrkesutveckling och produktivitet i tjänstesektorn, (Information technology for professional development and productivity in the service sector) is supported by Rådet för arbetslivsforskning and Nutek. The objective is to increase productivity and competence within the service sector. Six theme areas are supported:
  + IT support to public services
  + Telecommuting and decentralised production of services
  + Network based knowledge handling
  + Efficient and competence increasing interfaces between man and computer
  + IT for increased employment
  + System evaluation for more efficient usage of software.

  Source: Aktuell arbetslivsforskning, 2, 1995

5.4. IST Centres of Excellence

There are several interesting IST centres of excellence, some of them closely related to academic research, others the result of local efforts. Some of the centres are veritable incubators for new companies — in most of them there are several small and emerging IST companies, which are the results of spin-offs from academic research institutes. The list is not complete, but it gives an idea that it may be well worth the effort to search for such centres in Sweden:

* Satellitbild, Kiruna — global image analysis
* SoftCenter, Ronneby — software development by new and small companies
* TeleCity, Karlskrona — telecommunications
* Nocom Netscape Technology Center — Internet and WWW-technology
* Mjärdevi, Linköping — switching technology
* Ideon, Lund — mobile communications, software and systems development

5.5. Research Funding Agencies

Several organisations are acting as funding partners for various research projects. Some of the most important ones, supporting IST research and development in Sweden are:

* Kommunikationsforskningsberedningen, KFB
* Stiftelsen för strategisk forskning
* Stiftelsen för kunskaps- och kompetensutveckling
* Rådet för arbetslivsforskning
* NUTEK

KFB is a state agency, responsible for planning, initiating, coordinating, and supporting research, development, and demonstration projects regarding transportation, post and telecommunications, and the significance of these communications systems for environment, personal security, and regional development. The agency collaborates with other funding organisations in their support of research projects.

5.6. Do You Know This About IST Research and Development in Sweden?

* **Virtual Universities**

  The University of Gothenburg, Göteborgs Universitet, is trying to create a virtual university by offering all students, some 30 000, and employees, 5 000, IT-training, including a personal Internet homepage, e-mail addresses, and a modem connection to the university network. The traditional lecture halls will be replaced by some kind of coffe shops, where each table offers plug-in possibilities. The thinking behind this effort is that the university should be open to as many people as possible, which is not possible without information technology. Students will be offered the opportunity to follow courses from all over the world. The virtual university of Gothenburg can be reached via http:/www.vu.gu.se/VU. The mass training courses start in 1997. After 1998 computer illiteracy should be erased at the Gothenburg University. If everything goes according to plan.
  Source: Dagens Nyheter, Oct. 24, 1996

* **Rymdbolaget** at Esrange in Kiruna in the very northern part of Sweden is housing one million pictures from the Spot satellite, and 650 000 pictures from Landsat. This information serves as raw material to Satellitbild, a highly specialised corporation for the development of satellite pictures. The Esrange specialists also tap other satellites on information, often in collaboration with other earthbased satellite stations all over the globe. Should you want to know more about the Swedish rocket lauching facility, type: http://www.ssc.se.esrange/
  Source: Computer Sweden, 17 January 1997

* **Telecom City** in **Karlskrona** is the base of a new national research faculty for tele informatics. By the beginning of 1997, **the University of Karlskrona/Ronneby** was granted new professorships in tele traffic systems, software engineering, computer science, applied signal processing, along with business economics and management, and English. The faculty is concentrating on applied research related to the design and management of global communication systems. The companies within Telecom City collaborating with the faculty are: Europolitan, Global One, Sun Microsystems, Ericsson, Nokia, Telia, Karlskronavarvet, Radius, Kipling Information Technology, and Karlskrona Kommun.
  Source:Telecom City Newsletter, February 1997