



BEFORE

Benchmarking and foresight for regions of Europe

<http://www.before-project.org>

Programme: 6th Framework Programme.

Instrument: Co-ordination Actions.

Thematic priority: Integrating and strengthening the European Research Area.

ICT Sector in Estonia Foresight Study

Prepared by the Consortium of the BEFORE Project (<http://www.before-project.org>).

Edited by TELECYL Group (<http://www.telecyl.com>).

Co-financed by the 6th Framework Programme of the European Commission (<http://ec.europa.eu/research/fp6/>). The Sixth Framework Programme covers Community activities in the field of research, technological development and demonstration (RTD) for the period 2002 to 2006.

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Introduction

The **BEFORE Project** (<http://www.before-project.org>) was approved in the **FP6-2004-KNOW-REG-2** call for proposals of the **6th Framework Programme**. The specific programme covered was “**Integrating and Strengthening the European Research Area**” and the activity areas included were “**Coherent development of research and innovation policies**”.

The project will perform the comparative analysis (**benchmarking**) of efficient support instruments for the RTD in **geographical areas with demographic significant imbalances**. In this way also specific tools of support would be analyzed for rural companies and entrepreneurs. Also, there would develop a **panel of indicators of impact of the regional RTD support policies** in this type of regions, with special attention to the indicators of social impact.

A special attention will be paid to the case of regions that have obtained significant advances implementing RTD policies in the last years (for example, regions to which the good use of the resources has allowed or will allow to leave the Objective 1). In the consortium take part some regions of this type (Castilla y León, Brandenburg). These regions will carry out a task of mentoring on the rest of regions in the project.

One of the factors for success in the present project is the achievement of wide regional consensus and the involvement of regional RTD players in the project. A strong effort will thus be made in order to obtain this actor interaction, integrating key players in the management structure and widely **disseminating project results**. Also the benchmarking process will contribute to trans-national exchange of experience.

Other objective of the project is to carry out **foresight studies** of policies and support instruments to RTD guided to **future sectors**, intensive in knowledge and with high added value. The sectors being covered will be **aeronautical** (Castilla y León), **biotechnology** (South Estonia), **ICTs** (Mid Sweden, South Estonia and West Romania), **transport (logistics** in Brandenburg and **automotive** in West Romania) and **renewable energies** (Brandenburg, Castilla y León and Mid Sweden). The development of these new sectors will allow to the participant regions to maintain and promote equilibrium between the competitiveness of its basic industries and businesses and the bid to introduce new economic activities in sectors with good prospects of future.

The partners and their respective regions and websites in the BEFORE Project are:

✓ **ADEuropa Foundation (ADEUROPA)** (Castilla y León) (<http://www.adeuropa.org/>) as coordinator.

✓ **Brandenburg Economic Development Board (ZAB)** (Brandenburg) (<http://www.invest-in-brandenburg.com/>).

✓ **ADR West Romania (ADR)** (West Romania) (<http://www.adrvest.ro/>).

✓ **Institute of Baltic Studies (IBS)** (South Estonia) (<http://www.ibs.ee/>).

✓ **The County Administrative Board of Västernorrland (LSTY)** (Mid Sweden) (<http://www.y.lst.se/>).

✓ **The Policy Research in Engineering, Science and Technology (PREST)** (Victoria University of Manchester) (<http://www.mbs.ac.uk/prest>) as expert in the design of foresight activities.

This document is one of the two foresight studies to be elaborated by the region of South Estonia within this project. This foresight study focuses on the ICT sector and its impact in South Estonia's economy as one of the leading emerging sectors in the region.

This report builds on hands-on policy learning experience gathered throughout a number of efforts aiming at fostering ICT related futures thinking in Estonia. The above includes *Estonian eVikings* project implemented by Archimedes Foundation in 2001 – 2002, *eForesee* ICT foresight pilot implemented by Institute of Baltic Studies in 2002 – 2003, and *EST_IT@2018* foresight project implemented by Estonian Development Fund in 2008. We look at the foresight learning curve through-out different projects, as current research staff of the Institute of Baltic Studies has been active in all these projects.

This document refers to the experiences of ICT foresight in Estonia and has two parts: **Part One** describes state of the art in Estonian ICT sector and **Part Two** describes the most recent efforts and policy learning on ICT foresight in Estonia. Finally, the **Annexes** include several tables and figures of interest commented within this study.

Part One: Estonian ICT sector

Introduction

From the beginning of the 1990s, information and communication technologies have become of central importance in the high-technology industry, as well as in people's daily lives. As ICT is considered a strategic key technology in supporting socio-economic development, Estonian research and development strategy *Knowledge-based Estonia* has prioritised since 2001 ICTs, biotechnology and material technologies as key technologies areas for Estonia.

Estonia has a reputation of rapid and enthusiastic user as well as developer of novel ICT solutions. Estonian ICT sector, although on miniscule on global scale, is certain areas indeed relatively well developed. Development of government and financial sector applications, and ICT security systems could be considered as special strongholds of Estonia.

Estonia has paid special attention to development of electronic ID-card infrastructure which would open up myriad of new possibilities from on-line proof of identity up to replacement of library cards or public transportation ticket, or even Internet based e-voting in parliamentary elections. Electronic ID permits also to declare taxes on the web or set up a new officially registered business on-line and only in a couple of hours. Besides e-services, Estonian public sector and private companies have successfully implemented numerous mobile applications, solutions such as for example geographic positioning of 112 emergency calls made from mobile telephones, mobile parking or even taking a bank loan by a simple SMS. Another example of public sector ICT innovation is the citizen portal and data exchange layer X-road, which cross-links securely various government databases allowing, thus, to offer to citizens new more user friendly e-government services.

However, ICT sector faces also several challenges which restrain its further rapid development. Lack of science and technology graduates, scarce seed and venture capital and weak cluster linkages are some of the weaknesses of the ICT sector that limit the ability of companies to innovate and invest into development of new products and services. In 1990s, Estonian innovation policy was relatively weak¹. As a result, growth of science based

industries was significantly hindered. Hence, not surprisingly, Estonia's exports are dominated by traditional industries, such as wood processing, metal processing and machinery, while high-tech businesses (mainly producing communication equipment, computers and research equipment) accounting for about 5% of Estonia's exports and even smaller share of Estonian manufacturing value added².

Economic significance of ICTs

As Estonia's cost advantages have vanished in recent years very rapidly Estonian enterprises face an increasing pressure to upgrade their competitive advantages by investing into new technologies, knowledge and skills. This is also where true economic significance of ICTs becomes evident.

In this context, the rationale for selecting ICTs in Estonia as one of the key areas of science and technology policy does not differ in any way from any other advanced or catching-up economy³. The latest OECD and EC research have demonstrated that in recent years more than half of the productivity increase of the OECD economies has come from broad scale application of ICTs and the related organizational changes.

Hence, the ICTs are foremost important because of their transformation potential in upgrading various traditional industries and strengthening respectively the competitive position of a region in global competition, and not that much because of the share of the ICT sector itself in respective economy. Therefore, also foresight benchmarking activities undertaken within BEFORE project provide significant value added to the ongoing policy learning process in Estonia.

¹ Rainer Kattel & Tarmo Kalvet, *Knowledge-based Economy and ICT-related Education in Estonia: Overview of the Current Situation and Challenges for the Educational System*, Praxis: Tallinn, 2006; Tarmo Kalvet, Tarmo Pihl, Marek Tiits, "Analysis of the Estonian ICT Sector Innovation System. Executive Summary" Estonian eVikings, Archimedes Foundation: Tartu, 2002, <http://www.esis.ee/eVikings/>.

² Marek Tiits (ed.), *Kaupmeeste riik [The Nation of Merchants]*, Estonian Academy of Sciences: Tallinn, 2007.

³ Marek Tiits et al, *Made in Estonia*, Institute of Baltic Studies: Tartu, 2006, <http://www.ibs.ee/MiE>.

Crisis stricken world economy faces currently major financial turmoil and is about to enter major recession with all its consequences. Broad scale utilisation of ICTs and related organisational change will remain for longer term nonetheless major source of economic development. Hence, further development of new ICT infrastructures, ICT enhanced products, processes and services remains major challenge and opportunity.

Ongoing relocation of manufacturing from the U.S. and Western Europe to South East Asia, Eastern Europe, South Africa and elsewhere brings to Estonia both opportunities and threats. With the rapid loss of earlier cost advantages the rationale for locating production in Estonia needs to be re-thought. In this context, the main challenges for Estonian ICT sector lie in following years in continued strive towards higher value added activities – strengthening the capabilities for product development, and increasing export performance of the companies. This shift requires extensive state support and sector-specific policies ensuring the training of qualified workforce by the education system, supporting marketing activities.

Along the same token, continued rapid development of the services sector and modernisation of public sector are both very likely to create for ICT companies numerous incentives to launch new products and services ⁴.

Key facts and figures on Estonian ICT sector

In Estonia, there are today about 1500 ICT companies, whereas the market is rather concentrated. The eight biggest enterprises account for up to 80% of domestic market for ICT goods and services, while smaller firms carry out various sub-contracted activities and/or specialise on 'tailor made' software development. ICT services are dominated by telecommunication service providers, which produced in 2006 more than 50% of total sales of the sector. Computer services branch of Estonian ICT sector that includes also software developers is, however, much more fragmented. More than 1100 Estonian ICT companies belong to this segment, whereas less than 100 employ 10 or more persons. (see *Table 1 in Annexes*).

⁴ Tarmo Kalvet, "The Estonian ICT Manufacturing and Software Industry: Current State and Future Outlook", EC/IPTS, 2004.

At the same time, ICT manufacturing is dominated by a small number of branches of larger foreign manufacturing services providers. Office machinery and computer manufacturing is the smallest segment of the Estonian ICT manufacturing industry and mainly supplies local market.

Despite being among world leaders in taking up new ICT solutions, exports of Estonian ICT products and services lag far behind. In 2001, Estonian exports ⁵ of ICT goods (predominantly telecommunications equipment) were responsible for more than 25% of the total Estonian exports. In more recent years, Estonian total exports have doubled while the exports of ICT goods have declined twofold. Consequently, ICT goods were in 2007 responsible only for 5% of Estonian manufacturing exports. Notably, the value added and employment share of the ICT sector in Estonian economy has been always much more modest than suggested by its export share. This is foremost due to the dominant role of the Estonian branches of a few multinational electronics companies, which have located part of their production in Estonia, which acts largely as a low end assembly part of the respective global value chains. Consequently, ICT manufacturing in Estonia could be regarded in many ways as a sub-part of the Scandinavian ICT cluster, performing activities subcontracted and outsourced by Scandinavian enterprises.

The main umbrella organisation of the Estonian ICT sector is the **Estonian Association of Information Technology and Telecommunications (ITL)**, which represents a major share of the Estonian ICT sector, except the foreign investment dominated electronics industry, which does not belong to this industry association⁶.

⁵ In fact, most of the Estonia's ICTs exports can be attributed to the Estonian branch of Elcoteq, which is an international electronics and communication technology company. In Estonia, Elcoteq employs about 2900 people and has a share capital of 20.5 million EEK. See also: http://www.elcoteq.com/NR/rdonlyres/5EC17632-EE24-47E3-8A39-324CD03884DB/0/Elcoteq_ARo6_uk.pdf.

⁶ See also: <http://www.itl.ee>

Perceived opportunities and threats

A few years ago the *Estonian eVikings* project conducted an extensive study of the Estonian ICT sector innovation system. Over the last years the sector has faced quite extensive developments, but it appears that the main conclusions of the above study still hold: the competitive advantages of the Estonian ICT sector are still relatively weak, and the co-operation between different key actors in the system remains way too occasional to form a distinguished and internationally competitive ICT cluster (see Figure 1 in Annexes).

Estonian eVikings study concluded in 2002 with the following policy recommendations that hold very much even today:

- ✓ The cluster-based strategic planning approach should be utilised, as the under-development of some parts of value chain disadvantages the developments in other parts of the cluster. For the ICT sector there are few advanced support and demand conditions and the cluster linkages remain weak.
- ✓ The mismatch between the skills developed and the needs of industry should be addressed via well-targeted education and training policies. National R&D resources, which are indeed very limited, should be invested first of all into
- ✓ Strengthening the higher education and research system and improving human capital in the specific ICT areas of strategic importance for Estonia.
- ✓ Every effort should be made to enable public-private partnerships for improving IT graduate education, to support capacity building and initiate further shifts towards rising industrial IT R&D activity in Estonia. Baltic Sea regional cooperation could be also utilised for establishing 'Virtual University' type of schemes

As we show in Part Two, the recommendations deriving from *Estonian eVikings* have been taken with the following ICT foresight initiative(s) a step further.

Policy instruments

The three main action fields of the Information Society Strategy 2013 are⁷:

1. **Development of citizen-centred and inclusive society** (target: by 2013, 75% of Estonian residents will be using the internet and household internet penetration will amount to 70%).
2. **Development of knowledge-based economy** (target: by 2013, the productivity per employee in Estonian enterprises will account for 75% of the EU average and the share of ICT enterprises in the national GDP will amount to 15%).
3. **Development of citizen-centred, transparent and efficient public administration** (target: by 2013, citizen satisfaction with public sector e-services will reach 80% and satisfaction of businesses with public sector e-services will be 95%).

According to the strategy, the measures of the second action field comprise the promotion of ICT uptake by enterprises, and more importantly, **increasing the competitiveness of the Estonian ICT sector** by:

- ✓ **Bringing IT education in accordance with the requirements of the ICT sector.** Measures will include widening training opportunities for IT lecturers at vocational and higher education level; improving the apprenticeship system, and developing mechanisms to motivate post-graduate students.
- ✓ **Supporting the internationalization of the Estonian ICT sector.** Planned activities include making the software procured by the public sector available in order to avoid duplication of similar solutions and to facilitate the exports of Estonian ICT solutions; facilitating the participation of Estonian ICT enterprises in EU and international programmes and networks by supporting the preparation of project applications and ensuring the

⁵ Estonian Information Society Strategy 2013, Government of the Republic of Estonia, November 2006, http://www.riso.ee/en/information-policy/policy-document/Estonian_Information_Society_Strategy_2013.

availability of required national self-financing; facilitating the migration of highly qualified foreign labour; distribution, creation, and publishing of relevant standards.

- ✓ **Facilitating the development of high-quality and innovative information society and media services and settling intellectual property related issues.** Favourable environment will be ensured for the development of multimedia services provided via the internet, digital TV and mobile communications. Legal questions related to the principles of service provision will be solved.
- ✓ **Elaboration and implementation of principles concerning the outsourcing of services necessary for the functioning of the state information system,** i.e. standardizing the requirements and practices related to services outsourced in order to ensure the functioning of the state information system in a way that would improve the service quality of different components of the state information system, and favour the development of the market offering those services.
- ✓ **Increasing the role of the Estonian ICT sector in the development of the country's defensive capacity.** To this end, more use will be made of the potential of the Estonian ICT sector in organizing military offset contracts and in promoting civil applications related to development works in the field of defence.

Part Two: ICT foresight in Estonia

Introduction

Estonia has had since early 2000s a number of attempts at initiating fully fledged ICT foresight exercise. Hence, to put ICT foresight related policy learning in Estonia properly in context, and to make it understandable for the purposes of international comparison in BEFORE project, one has to start with describing the evolution of the idea and steps taken by various initiatives.

As described in part one, in 2001 – 2002 Archimedes Foundation run *Estonian eVikings* project that assessed state of the art of Estonian ICT sector innovation system, but made also a rudimentary attempt at initiating ICT related futures discussion⁸.

The above first steps were followed by *eForesee* ICT foresight pilot undertaken by Institute of Baltic Studies in 2002 – 2003. In this work, comprehensive study into long waves in economic development, Estonia's mid-to-long term main socio-economic challenges, and main global technology trends in ICT, biotechnology and nanotechnology was undertaken. The results of this work were published as *Made in Estonia* a book that described besides the above also three scenarios on future development of Estonian economic policy and economy⁹.

The above, although significant in terms of theoretical reach and policy implications, did not bring, however, any specific policy actions for strengthening the ICT sector itself. Thus, it was one of the key lessons from earlier experiences that **it is counterproductive and clearly not advisable to launch any additional foresight exercise(s) which does not have a very clear prospect of actual take-up of its results at actual policy making level.**

In 2008, Estonian ICT and innovation policy landscape changed. Freshly established Estonian Development Fund¹⁰ recognised the importance

of ICTs for Estonia's socio-economic development and decided to launch ICT foresight initiative that would contribute to the establishment of a shared vision on future of Estonian ICTs. The above was to cover both priority setting in development of ICTs themselves and identification of application areas, where the use of ICTs could bring about the greatest benefits.

Thus, the EST_IT@2018 foresight project set to consolidate the views of the industry and academia and to inform Ministry of Education and Research & Ministry of Economic Affairs and Communications on priority setting for prospective ICT development programme.

This foresight project was executed in close collaboration with Estonian Association of Information Technology and Telecommunications; also a number of individuals from companies, government and academia (incl. from the Institute of Baltic Studies) have supported this exercise with their manpower and earlier ICT foresight experience.

EST_IT@2018 foresight process – problem solving approach

Preparation of the foresight exercise started in early 2008. After series of extensive consultations with stakeholders and foreign methodology consultants, the project was formally launched with Steering Group meeting in May 2008.

EST_IT@2018 foresight exercise conducted in May–December 2008 aimed at gathering technological intelligence on main global trends development in development of ICTs, and establishing a shared vision on future contribution of ICT to the development of Estonian economy and society.

We acknowledge that globally main ICT development trends are shaped by major industrialised economies, such as the United States, 'core Europe' and Japan, that account for vast majority of industrial R&D investments. Estonia is not to compete with the above big nations in defining main global technology trends neither in ICT nor in other technology domains.

⁸ Tarmo Kalvet, Tarmo Pihl, Marek Tiits, "Analysis of the Estonian ICT Sector Innovation System. Executive Summary" Estonian eVikings, Archimedes Foundation: Tartu, 2002, <http://www.esis.ee/eVikings/>

⁹ Marek Tiits et al, *Made in Estonia*, Institute of Baltic Studies: Tartu, 2006, <http://www.ibs.ee/MiE>.

¹⁰ Estonian Development Fund is a public law entity founded by the Estonian Parliament. The Fund performs risk capital investments into technology based startup companies and carries out socio-economic and technology foresight. See <http://www.arengufond.ee>.

Two: ICT foresight in Estonia

The main opportunity and challenge for small catching up economies like Estonia is rather to be early and active user of technologies developed elsewhere, and to be very closely and favourably integrated into various international business alliances so that the ICT applications piloted at home could be also exported relatively rapidly to various international markets.

Given the above, the initial scoping phase of the Estonian ICT foresight mapped:

- ✓ Global ICT development trends that are expected to have potentially the greatest impact on development of Estonia.
- ✓ Estonia's main socio-economic challenges and possibilities for meeting these with take-up of novel ICT applications and related change.

In mapping global ICT technology trends, foresight exercises and ICT R&D strategies of major players were the main source of information. The knowledge acquired from literature review was complemented with series of semi-structured interviews with key players in ICT in Estonia. Furthermore, the above interviews served also as an input on possible novel uses of ICTs that would allow Estonia to meet series of challenges it faces either because of demographic challenges or other resource constraints in modernisation of education, medical, and social care systems, etc.

Following the above introductory mapping efforts, in the end of July 2008, full day workshop was held to present and discuss main ICT trends and their prospective role in meeting main socio-economic challenges Estonia is likely to face in coming decade.

During this workshop series of thematic brainstorming sessions dedicated to development of visions on future ICT enabled environments in the above socio-economic key areas are held. These visions are expected demonstrate the potential ICTs have for increasing in quality of certain specific services or reducing the related costs of provision.

The outcomes of the above workshop were incorporated into updated working document which included now validated list of global (European) main ICT trends and 19 key mid-to-long term socio-economic challenges faced by Estonia.

Based on the above, to map Estonia's competitive position vis-à-vis global (European) priorities and assess the importance of the above key socio-economic challenges in August-September 2008 on-line survey was prepared and executed. With this questionnaire in each of the challenge areas Estonia's competences, domestic barriers to change, and prospects for growth of international demand for related ICT solutions were assessed. As with each of the previous steps, the above on-line survey engaged even broader set of experts, thus contributing to increased visibility of the exercise.

As the result of the project both **Estonia's current strengths and future need for ICT competences** were mapped (see *Figure 3* in *Annexes*), also based on the above list of opportunities and socio-economic challenges **6 focus areas for application of novel ICT solutions** were identified. These six focus areas are: financial services and ICT security systems (both current strength), education, manufacturing, energy supply and energy efficiency, and health care (prospective future growth markets) (see *Figure 4* in *Annexes*).

The above technological competence mapping will serve as input for strengthening Estonia's ICT related higher education and public good research, whereas the analysis of socio-economic trends forms the basis for development of future more focussed road-maps and investment plans.

To present and discuss final results of the project, and to prepare for possible follow-on road-mapping initiatives in above 6 focus areas, in December 2008 high level conference was held.

Outputs and outcomes

Main formal result of EST_IT@2018 foresight exercise is final report which is due to be published by *Estonian Development Fund* in early 2009. This report:

- ✓ Reviews main global ICT trends and maps based on the above the priorities for upgrading Estonia's ICT competences.
- ✓ Characterises state of the art in economic development of Estonian ICT sector, and compares current market orientation vis-à-vis prospective future growth patterns of global ICT markets.

Two: ICT foresight in Estonia

- ✓ Assesses Estonia's main socio-economic challenges, and indicates for each of the 6 focus areas possible role ICTs could play in meeting the above challenges.
- ✓ Finally, policy recommendations and key lines of action are presented.

Policy recommendations

EST_IT@2018 foresight exercise offers two broad lines of policy recommendations:

- ✓ Firstly, it advocates that Estonia needs to strengthen significantly its ICT related higher education and public good research; it is proposed that Estonia should seek at attracting from abroad a number of strong professors, while supporting more actively also studies of Estonian ICT (post-graduate) students abroad.
- ✓ Secondly, it highlights the importance of proactive and more selective foreign direct investment policy and intelligent execution of lead market initiatives and more systematic use of public procurement as the means of modern innovation policy.

Annexes:

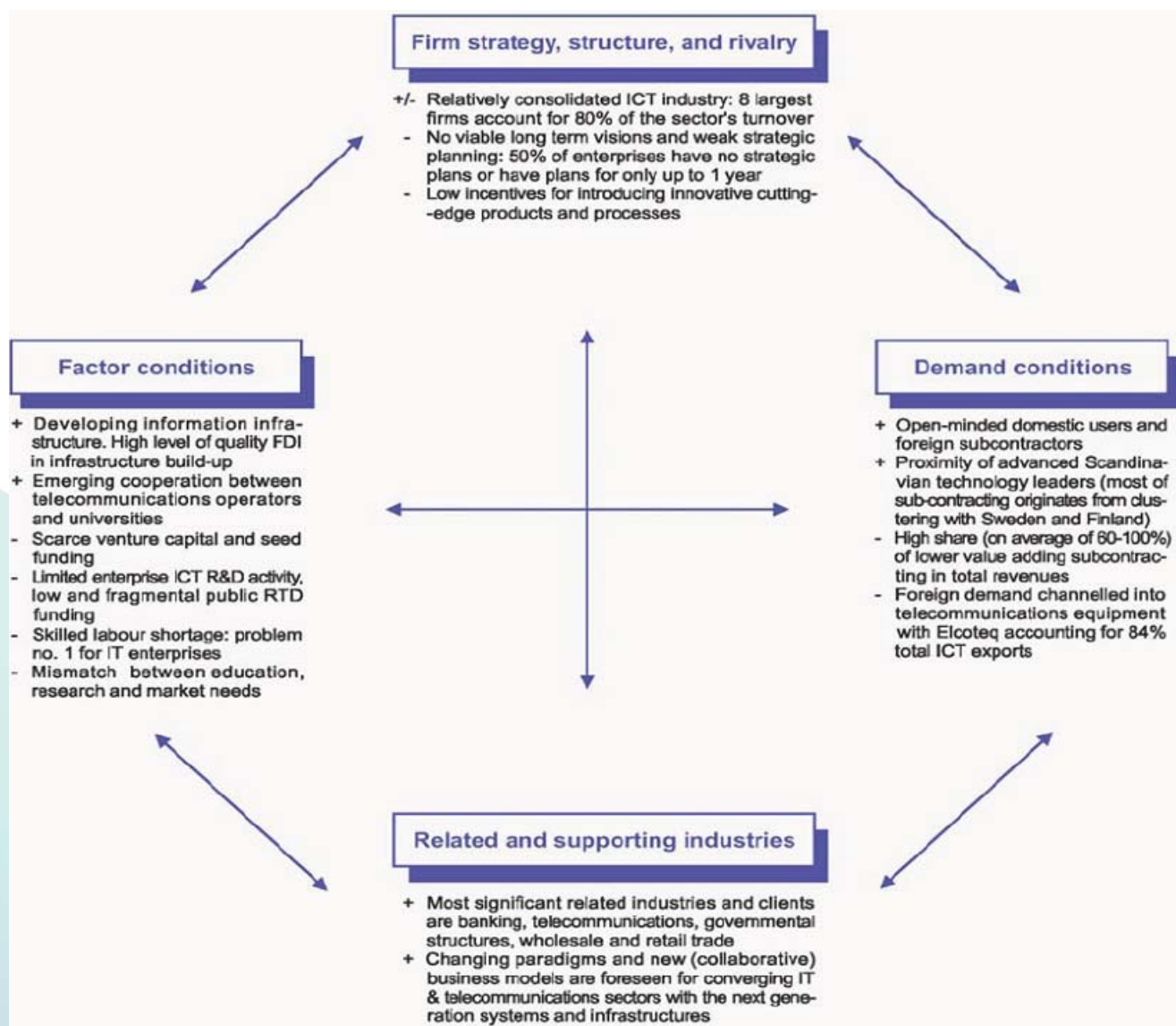


Figure 1. Estonian ICT cluster – Porter's diamond.

Source: Adopted from Tarmo Kalvet et al, Analysis of Estonian ICT Sector Innovation System. Executive summary, Archimedes Foundation: Tartu, 2002, <http://www.esis.ee/eVikings/>.

Annexes

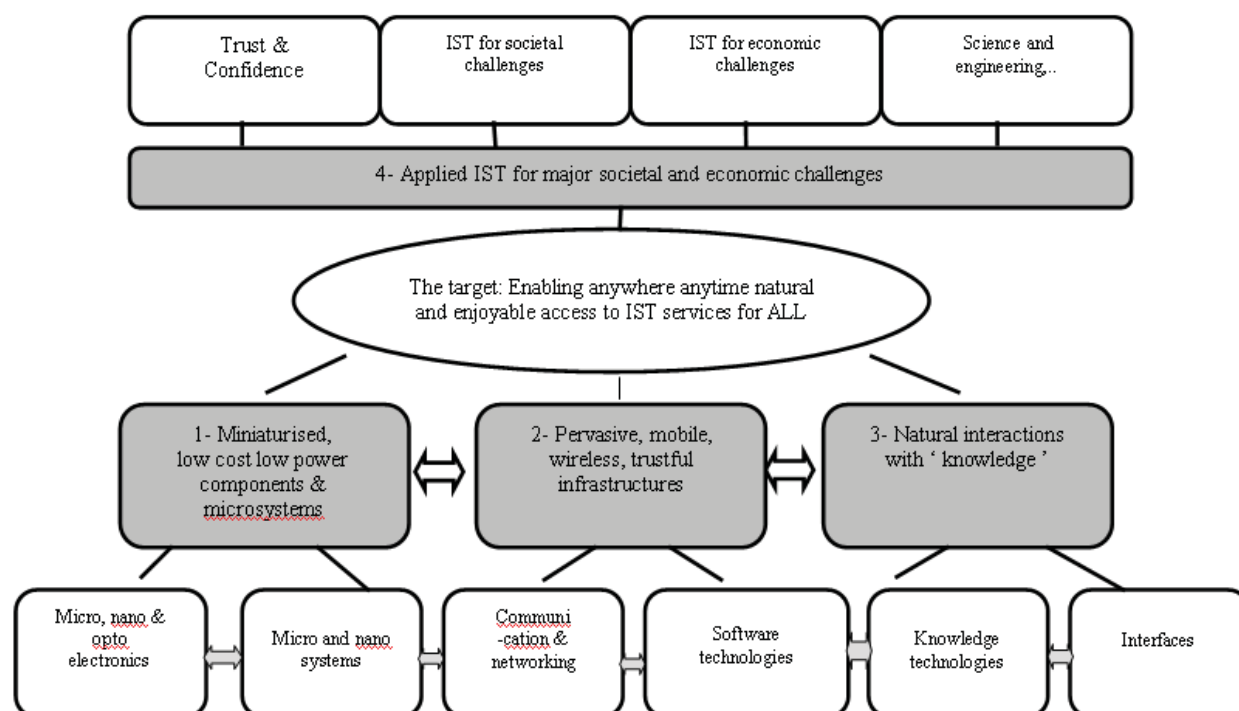


Figure 2. Structure of European IST R&D priorities.

Source: IST research in FP6, European Commission DG INFSO, October 2001.

	Manufacture of office machinery and computers	Manufacture of radio, TV and communication equipment	Manufacture of medical and optical instruments, etc.	Post and telecommunications	Computer and related services
Number of enterprises	16	86	135	134	1151
Average number of employees	273	6083	1923	7902	5137
Net sales, in million €	58.7	245.1	106.8	713.3	213.1
Sales to non-residents, in million €	5.0	225.4	78.8	57.1	66.4
Research and development expenses, in million €	0.1	4.6	1.1	0.1	16.2
Personnel expenses, in million €	3.3	50.8	20.8	88.2	81.6
Depreciation, in million €	0.3	17.4	2.2	59.4	6.3
Operating profit (loss), in million €	2.1	10.7	20.0	163.6	12.8
Net profit (loss), in million €	2.0	8.3	18.8	148.5	-5.1

Table 1. Key economic indicators of Estonian ICT sector.

Source: Statistics Estonia. <http://www.stat.ee> November 2008

Annexes

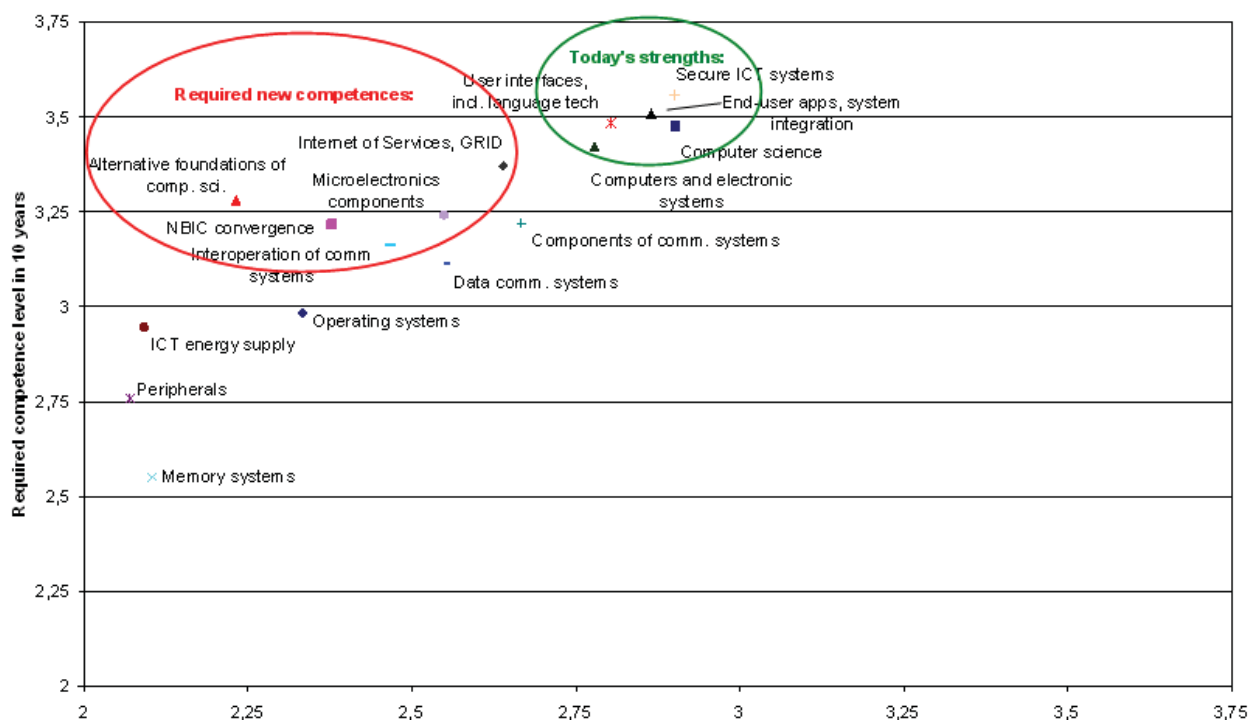


Figure 3. Estonian ICT competences vis-a-vis European and global R&D trends.

Source: EST_IT@2018 web survey, Estonian Development Fund: Tallinn, 2008.

Legend: 2 = able to use, 3 = able to modify and develop further, 4 = internationally competitive in development respective ICT systems

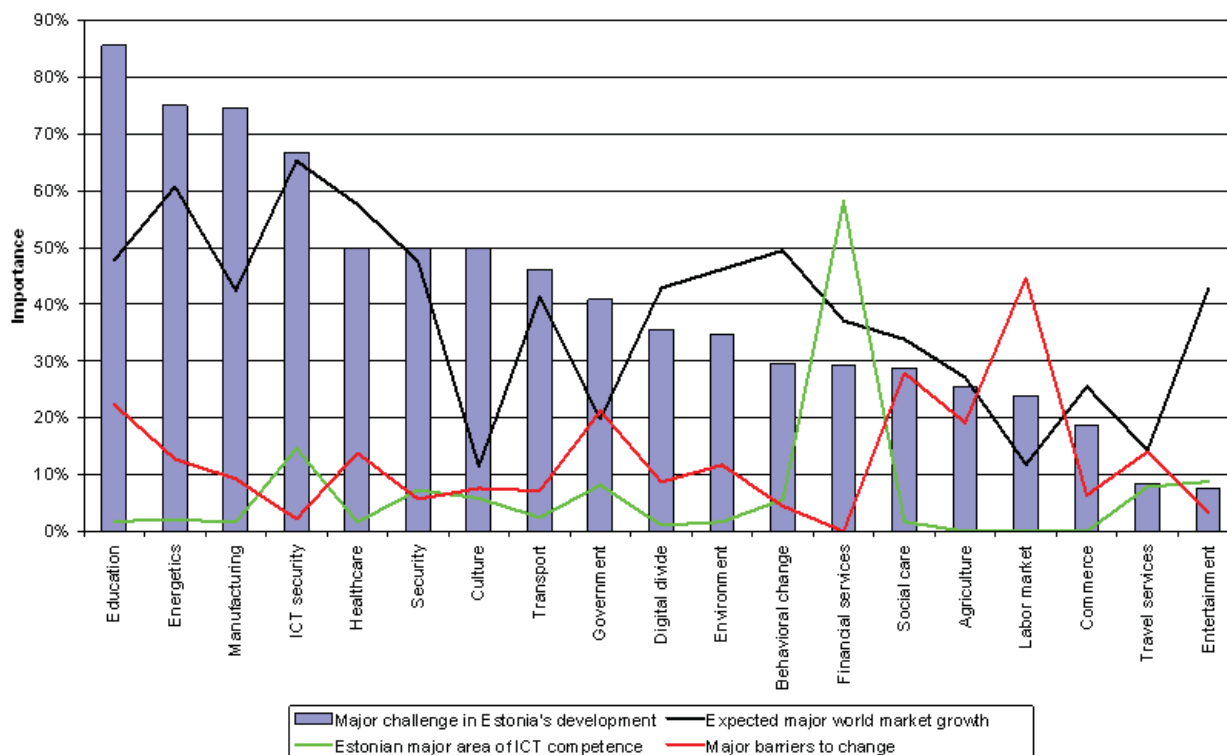


Figure 4. Estonia's key socio-economic challenges.

Source: EST_IT@2018 web survey, Estonian Development Fund: Tallinn, 2008.