

Centre of Excellence in Computer Science, EXCS (2008–2015)

Tarmo Uustalu, Institute of Cybernetics at TUT



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EXCS in one slide

- A national **centre of excellence in research** (CoE) 2008–2015
- dedicated to the study of **computer science** and computational sciences,
- funded within the Measure for the development of CoEs of the Estonian system for the implementation of the EU Structural Funds 2007–2013,
- composed of researchers at the **Institute of Cybernetics** at TUT (IoC), **Cybernetica AS** (CybAS) and the **University of Tartu** (UT),
- coordinated by IoC, project leader Tarmo Uustalu.
- <http://cs.ioc.ee/excs/>
- One of the 7 CoEs funded within this measure (across all disciplines), selected from 24 proposals in spring-summer 2008.

Financing

- Budgeted eligible cost for the structural funds during the 7-year duration is 69.9 MEEK.
- **Structural assistance** comes from the European Regional Development Fund, ERDF, and amounts to 95 pct, i.e., 66.4 MEEK (ca 4.25 MEUR).



- The Estonian state contributes an **additional grant** of 3.8 MEEK (ca 0.25 MEUR)
- and **compensates** for the ineligible **VAT**.
- The measure is administered by the Ministry of Education and Research and the Archimedes Foundation.

Other Estonian CoEs 2008–2015

- ① Frontiers in Biodiversity Research, FIBIR (UT)
- ② CoE in Genomics (EBC, UT)
- ③ CoE for Translational Medicine, CETM (UT)
- ④ CoE in Chemical Biology, CECB (TUIT, UT, EBC, TUT)
- ⑤ CoE in Cultural Theory, CECT (UT, TLU/EIH)
- ⑥ Centre for Integrated Electronic Systems and Biomedical Engineering, CEBE (TUT)

Institutions and people (1)

- The participating institutions and people are determined by four HTM **target-financed themes**, led by Tarmo Uustalu, Ahto Buldas, Jaak Vilo, Mare Koit.
- Three **institutions**:

- Institute of Cybernetics at TUT



- Cybernetica AS (via its non-profit making Information Security Institute)



- University of Tartu (through its Dept of Computer Science)



Institutions and people (2)

- (As of 1 March 2009) 54 **senior staff**:
3 DScs (Ülo Jaaksoo, Enn Tõugu, Haldur Õim, all members of the Estonian Academy of Sciences), 45 PhDs and CScs, 6 MScs
- 60 **PhD/MSc students**
- The core is a **young generation** of Estonian CS research leaders:
Ahto Buldas, Peeter Laud, Sven Laur, Helger Lipmaa, Kaili Müürisep, Tarmo Uustalu, Eero Vainikko, Varmo Vene, Jaak Vilo + Marlon Dumas, the Swedbank professor of software engineering at UT.

Objectives

- General objective:
to consolidate and advance the Estonian computer science in **six areas of recognized strength**.
- Specific objectives:
to **boost the research potential** of the groups involved by facilitating collaboration and safeguarding their sustainability and growth,
to **increase the impact** of their research results in academia, industry and society as well as to popularize them.
- To be achieved by:
carefully planned **coordination and joint actions**, to create a **thriving, highly reputed research environment**, attractive for young researchers, in particular from abroad.

Activities

- The activities to EXCS fall into two groups:
 - coordinated **research**:
regular research activity, aiming at the highest quality and emphasizing, in particular, collaboration across institutions and topic areas
 - coordinated **support actions**:
specific actions targeted at developing the research potential of the groups involved and increasing the impact

Working groups (WGs)

- The research activities of EXCS are centered around 6 thematic **working groups (WGs)** (for the 6 areas of strength):
 - programming languages and systems (PLS),
 - information security and cryptology (Sec),
 - software engineering (SE),
 - scientific and engineering computing (Comp),
 - bioinformatics (BI),
 - human language technology (LT)

These cross the TFT and institution boundaries wherever appropriate.

WG research areas (1)

- **Programming languages and systems**

design of type-theoretical programming languages;
program logics/type systems for to certify code in mainstream languages; static analysis of multithreaded code;
algebraic and categorical automata theory and theory of context-dependent computing;
hybrid systems verification and testing

T Uustalu, V Vene, H Nestra, J Penjam, T Tamm,
M El-Zawawy, K Nakata, S Capobianco, J Chapman +
J Vain, J Ernits (IoC + UT)

- **Information security and cryptology**

secure communication protocols for oblivious transfer,
e-voting, privacy-preserving information retrieval, secure
function evaluation in general, time-stamping etc;
security assessment of information systems

A Buldas, P Laud, H Lipmaa, I Tšahhrirov (CyBAS + UT)

WG research areas (2)

- **Software engineering**

service-oriented architectures, rapid aggregation of services, incl ontology induction, data mining to assess architectural quality of service-oriented systems

M Dumas, I Astrova, H-M Haav, A Kalja, P Küngas (UT + IoC + CybAS)

- **Scientific and engineering computing**

parallel algorithms for solving large computational problems, system DOUG for solving large systems of linear equations; middleware for GRID and P2P computing, friend-to-friend (F2F) computing; knowledge-based tools for engineering computations, modelling and simulation

E Vainikko, M Harf, U Norbistrath, E Tõugu (UT + IoC)

WG research areas (3)

- **Bioinformatics**

interpretation of biological data through novel advanced algorithmic designs using machine learning and data mining, visualization, techniques for hypothesis prioritization; dissection of gene regulation mechanisms, reconstruction and analysis of genetic networks, gene expression data mining

J Vilo, S Laur (UT + CyBAS)

- **Human language technology**

linguistic changes of Estonian for computer processing of written Estonian; sentence and discourse modelling, dialogue modelling for written Estonian;

models for Estonian speech recognition, coping with signal variability, spontaneous and emotional speech

M Koit, K Müürisep, T Alumäe, K Jokinen, H-J Kaalep, K Kaljurand, T Kirt, E Meister, K Muischnek, M Traat, H Õim (UT + IoC)

Research activities

- The research activities comprise:
 - research within the WGs,
 - cross-WG research efforts,
 - dissemination,
via high-level scientific publications, tutorials, intensive courses,
seminar talks at foreign universities, the centre's web portal
- The MC monitors the quality of the centre's publications and other dissemination.

Support actions

- The support actions go into strengthening the centre and increasing its impact.
- **Strengthening the centre:** making it a sustainable **thriving research environment** capable of attracting and keeping talent.
 - **Human resources:**
 - positions for **postdocs** PhD students, technical personnel,
 - training.

Personnel development is conducted in adherence to the **European charter** for researchers and code of conduct for the recruitment of researchers.

- **Equipment.**

Most of the centre's funds are put into personnel and equipment.

- **Increasing the impact:** enhancing the centre's **visibility**, i.e., raising the awareness of the target groups of the centre's research results.
 - **International cooperation:**
 - organization of high-level scientific events,
 - international cooperation projects.
 - **Technology transfer:**
 - contact days for industry,
 - industrial cooperation projects.
 - **Contribution to policy-making:**
 - contributions to shaping of policies in R&D, higher education and IT related areas, technology roadmapping and foresighting, standardization etc
 - **Popularization:**
 - media coverage,
 - popular books,
 - open-door events for the general public

Management

- **Management committee (MC):**
operative management, consists of the leaders of the 4 TFTs and the leaders of the WGs
- **General assembly (GA):**
institutional strategy, consists of institution administration representatives (one from each) + the leaders of the 4 TFTs
- **International advisory board (IAB):**
scientific advice, consists of internationally renowned researchers from abroad
 - Ivan Damgård (U. of Aarhus),
 - Reino Kurki-Suonio (Tampere U. of Techn.),
 - Kim G. Larsen (Aalborg U.),
 - Heikki Mannila (Helsinki Inst. of IT),
 - José Nuno Oliveira (U. do Minho),
 - Martin Volk (U. Zürich),
 - Reinhard Wilhelm (U. des Saarlandes).

Track record

- Long-standing successful cooperation between the consortium partners, formalized in particular in the EU FP5 project **eVikings II** (2002–2005) and the Estonian CoE **CDC** (2002–2007).
- Main players on the Estonian computer science scene.
- Esp during the last 5 years a very strong emphasis on **internationalization**:
active involvement in FP5/6/7 and other int projects,
active organizers of high-level int conferences in Estonia,
highly reputed int winter schools in TCS since 1996,
visiting researchers etc
- A **young generation** of research leaders, several from PhD degrees and/or postdoctoral research experience from abroad.

EXCS vs CDC

- CDC (the Centre for Dependable Computing) was one of Estonia's 10 national CoEs 2002–2007 funded by the Estonian state.
- Roughly,

EXCS = CDC

- computer engineering
- + bioinformatics
- + human language technology

- The computer engineering part, supplemented with **electronics** and **biomedical engineering**, spawned another successful CoE proposal in IT, **CEBE**, <http://cebe.ttu.ee/>.
- So 1/10 became 2/7!

EXCS vs Estonian computer science

- EXCS encompasses most of the computer science research done in Estonia, except
 - **automated theorem proving**, semantic web by T Tammet at DCS/TUT,
 - **proactive systems** research by L Mõtus, M Meriste at DCC/TUT and TUIT
 - **information systems** and other research pursued at DInf/TUT,
 - **robotics** research by M Kruusmaa at Biorobotics/TUT
 - **social software** research at TLU.
- Major opportunities to overcome fragmentation and harvest synergy.

EXCS values

- High-quality **research** has **priority** over any other activity. Nonsense cannot be afforded.
- **People** matter most.
- Quality of research is defined by recognition by **true experts** (the international research community) rather than spreadsheet software.
- Indicators to assess research must be meaningful and **fair**.

Support actions 2008–2009

- **postdoc recruitment campaign** of autumn 2008
(5 international postdocs recruited on 1..2-year positions)
- a number of **training events** for EXCS members, high-level **international conferences, industry contact events** (IST 2008, IST 2009)
- activity in **EU R&D projects**
- activity in **industry project initiatives**, incl the Measure for assistance for technology development centers of the EU Structural Funds 2007–2013
- popularization activities (translation of a **book** by D Harel, activities at European **Researchers Night** 2009)
- general publicity (presence at **Research Connection** 2009 exhibition, Prague)

Events 2008

- NordForsk researcher network **VISPP** summer school **2008**, Kuressaare, 10–16 Aug 2008 (N Campell, B Granström, J Local)
- 7th Est Summer School in Comput and Syst Sci, **ESSCaSS 2008**, Otepää, 24–28 Aug 2008 (A Avižienis, R Baeza-Yates, F Menczer, A Rensink)
- EXCS **kick-off meeting**, Tallinn, 18–19 Sept 2008, with industry and popular CS and fresh PhDs sessions
- Comput Sci **Theory Days** at **Jõulumäe**, 3–5 Oct 2008 (A Ambainis, K Cirulis, R Freivalds et al from Riga)
- Symp on Innovative Software Technology, **IST 2008**, Tartu, 27–28 Oct 2008 (A ter Hofstede, B Kiepuszewski, A Tai)
- 20th Nordic Wksh on Programming Theory, **NWPT 2008**, Tallinn, 19–21 Nov 2008 (D Clarke, V Danos, M Fränzle, M Veanes)

Events 2009

- COST action **IC0701** training school **2009**, Viinistu, 25–29 Jan 2009 (C Haack, R Hähnle, E B Johnsen, C Marché, A Poetzsch-Heffter)
- Comput Sci **Theory Days** at **Kääriku**, 30 Jan–1 Feb 2009 (S Park)
- 14th Est Winter School in Comput Sci, **EWSCS 2009**, Palmse, 1–6 March 2009 (N T Courtois, P Dybjer, R Gennaro, P W Goldberg, M Müller-Olm)
- 8th Est Summer School in Comput and Syst Sci, **ESSCaSS 2009**, Jäneda, 23–27 Aug 2009 (Ch Elkan, K Jensen, W van der Aalst, N N)
- Comput Sci **Theory Days**, Sept/Oct 2009 (E Hirsch et al from St Peterburg)
- 3rd Symp on Innovative Softw Techn, **IST 2009**, Tartu, Oct/Nov 2009

EU R&D projects in execution



- IST coord action **TYPES** (proof assistants, dependently typed languages) (2004–2007, IoC, partner)
- IST integ project **MOBIUS** (proof-carrying code for small devices) (2005–2009, IoC, partner)
- IST integ project **AEOLUS** (overlay computers) (2005–2009, CybAS, partner)
- IST STREP **BalticTime** (timestamping and e-government) (2006–2009, CybAS, partner)
- LifeSciHealth STREP **COBRED** (colon and breast cancer diagnostics) (2007–2010, UT, partner)

EU R&D projects in execution (ctd)



- ICT STREP **RoboSwarm** (intelligent robot swarms) (2006–2009, TUT, coordinator)
- ICT collab action **VirtualLife** (security in virtual life) (2008–2010, CybAS, partner)
- Infrastructures prep phase project **CLARIN** (common language resources and technology infrastructure) (2008–2010, UT, partner)



- action **IC0701** (verified object-oriented software) (2008–2012, Estonia, signatory, T Uustalu, MC member)
- action **IC0702** (soft computing and statistical methods for data analysis) (2008–2012, Estonia, signatory, J Vilo, MC member)

Issues

- Permanent **shortage of people**, esp PhD students, technical personnel (easier to get a highly qualified postdoc from abroad than a lousy local PhD student)
- **Bureaucracy**: tedious cost claim process, rigidly fixed workplan and indicators
- Inconsistent policy, **incompetent governance**: failed research assessment exercise, national programme in ICT has taken a decade to not start, past experience neither analysed nor taken into account (new CoEs measure, new programmes for PhD education)

Technology presentations today

- Einar Meister, IoC, LT WG, Estonian speech technology
- Ahto Buldas, CybAS, Sec WG, attack trees in practical security
- Peep Küngas (PhD, NTNU, 2006), UT (EXCS postdoc), SE WG, analysis of service networks