INFORMAATIKA, INFOTEHNOLOOGIA, SÜSTEEMITEHNIKA (INFORMATICS, INFOTECHNOLOGY, SYSTEM ENGINEERING) III

Higher Education Quality Assessment Center of Estonia

Evaluation Report

Research evaluation in information technology and systems engineering in Estonia

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1. Introduction

The subject of this evaluation report is the research in information technology (IT) and systems engineering at University of Tartu and Tallinn Technical University in Estonia. Information technology and systems engineering is a very wide area ranging from semiconductor technology and chip design at one extreme, over electronics, computer science, software engineering, and automatic control, to applications in biomedical systems and large scale information systems at the other extreme. This makes an evaluation of this type particularly difficult. The topic is so wide that it is impossible for a single individual to cover it all. The evaluation team consists of four members: Prof. Karl-Erik Årzen from Lund University, Sweden, Prof. Janis Grundspenkis from Riga Technical University, Latvia, Prof. Kai Koskimies from Tampere University of Technology, Finland, and Prof. Peeter Normak from Tallinn Pedagogical University, Estonia. The expertise of the evaluation team lies within the areas of automatic control and real-time systems, artificial intelligence and systems engineering (systems theory, analysis and design), software engineering, and theoretical computer science and didactics of informatics. Hence, not even the team as a whole has technical expertise covering the entire area.

The subject of this evaluation is four different academic units: the Department of Information Technology (DIT) at the Center for Strategic Competence (CSC), Tartu, the Institute of Computer Science (ICS), University of Tartu (UT), the Faculty of Information Processing (FIP) at Tallinn Technical University (TTU), and the Faculty of Systems Engineering (FSE), TTU. The evaluation does not cover the whole IT-related research in Estonia. In a previous evaluation in April 2000, the Institute of Cybernetics at TTU and Cybernetica Ltd in Tallinn were evaluated separately; research done in Tallinn Pedagogical University deals mainly with didactics of informatics and belongs to educational sciences. The research group working at the Computer Center of Tallinn Technical University was not proposed to be evaluated. They are therefore left out from this evaluation.

The evaluation report is structured in the following way. Section 2 contains some general observations concerning the current situation for Estonian research in IT and systems engineering. The evaluation of the two Tartu-based groups is contained in Section 3. Today at TTU the departments within IT and systems engineering are divided into two faculties in a not so very logical way. The reason for this is partly historical and partly due to personal conflicts. Work on integrated circuits is performed within both faculties. The same situation exists for signal processing, microwave engineering, and for agent-based software technologies. The following evaluation should be read in light of the current situation. Some suggestions for improving the current situation are found in Section 6. The evaluations for the two TTU-based faculties are contained in Section 4 and Section 5. Finally, Section 6 contains our general recommendations and conclusions for the two involved universities and for Estonian research funding agencies.

In most cases evaluation grades are given for the individual research groups or chairs. However, in some cases several groups or chairs work tightly together or have chosen to report their research as a single unit. In that case the evaluation grades are given for the total research unit, e.g., a department. The evaluation team has used the following criteria as the basis when assigning grades. The grade **Excellent** is used for research units that have a very strong international publication record, have good participation in the international research community, have generated several completed PhD theses and have several in progress, have a strong group, and where the future prospects for the area are good. The grade **Good** is used for research units that have showed continuing high-level international publications, have some participation in the research community, have generated at least one completed PhD thesis and have several in progress, have a strong group, and where the future prospects for the area are good. The grade **Satisfactory** requires that the group have some international publications, although on a weak level. Interval grades are given. The grade **Good to Satisfactory** is better than **Satisfactory to Good**.

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4.3 Department of Informatics

Department of Informatics has been founded in 1992. The department has 4 chairs (Information Systems, Software Engineering, Foundations of Informatics, Knowledge-Based Systems) and 2 spin-off firms of TTU – Komptuur Ltd. and Index_Net Ltd. Ass. Prof. Rein Kuusik, director, who gave the survey of the department, pointed out that a large number of teaching staff and students have left for industry during recent years. The overview of research and development in the department was given by Prof. Jaak Tepandi. The staff of research and development during the period is as follows: 1 DrSc,

6 PhD, 12 MSc. Basic funding is 345 kEEK. The characteristic feature of research and development activities is a wide variety of research topics (no good focused research direction can be defined). To some extent three main directions can be listed: knowledge-based systems and software quality management (supervised by the Chair of Knowledge-Based Systems and the Chair of Foundations of Informatics), software engineering (supervised by the Chair of Software Engineering), and information systems (supervised by the Chair of Information Systems). The group has achieved the following main results: new testing and auditing methods for distributed uncertain knowledge based systems, a novel approach to knowledge based software testing, a new agent-oriented methodology for modeling, design and business information systems, and a global electronic commerce methodology have been developed. The department is active in establishing contacts with industry and carries out several very application oriented research projects. This may cause a decrease of the basic research competence level in the future.

The research activities are connected with studies – 4 PhD and 33 master thesis are defended in this group. Nine PhD theses are in progress. Currently there are 2 projects supported by Estonian Science Foundation, 1 TEMPUS project, and 1 PhD grant. The group has 67 scientific papers, of which a large part is local publications.

The following topics were presented to the evaluation team;

- Agent-oriented methodology for the modeling, design and implementation of business information systems (Kuldar Taveter)
- Information system self-development in virtual learning organizations (Mart Roost)
- Multimedia learning and communication (Assoc. Prof. Jaak Henno)
- Internet as a tool for rehabilitation (Assoc. Prof. Kaido Kikas)
- Buyers decision support system (Assoc. Prof. Enn Õunapuu)
- Monotone system theory, overview of PhD and MSc thesis work (Prof. Emeritus Leo Võhandu), see **http://www.datalaundering.com/mono/extremal.htm** , N.B. by J.M.

Research focused towards development of agent-oriented methodologies matches the hot topics of AI and is intensively investigated at the international level. This is a very promising direction for the group that may lead to the defined goal of the research: elaboration of methods and tools for analysis, design, implementation and quality management of large distributed and knowledge-based systems with complex structure, semantics and behavior. In this context, research in the field of distributed knowledge-based systems is relevant for the group. The competence of the research group in the above directions is high.

Several small teams are working in the field of e-commerce and Internet applications. Research in this direction is very strongly application driven. E-commerce is needed by Estonian industry and that may cause problems to form a really strong research team without danger to quickly loose the students.

The evaluation team had the opportunity to meet PhD students, to visit laboratories and to get acquainted with equipment and software used in teaching and research as well. All facilities correspond to the needs of the group.

Evaluation and recommendations

The department has novel results from research and development. The quality of research and development partly corresponds to the international level. The group is not successful in applying for funds and grants. On the other side the group has strong contacts with industry and good innovative experience. The results are applied in various fields of Estonian economy and industry. International co-operation is not intensive enough. The number of publications in high level international conference proceedings and journals (including joint publications with foreign scientists) is relatively small (11 out of total 67). The group has rather high potential of young researchers but the present structure of research activities implies a high risk to loose young researchers. The evaluation team recommends the department to define a research and development strategy that allows synergy effects from research in various fields, and to create an environment where most of the staff can participate in research and development.

Overall rating of the department: **Good to Satisfactory**.