INFOTEHNOLOOGIA TEADUSKOND
INFORMAATIKAINSTITUUT
TEADUS- JA ARENDUSTEGEVUSE AASTAARUANNE 2012

1. **Instituudi struktuur**

Informaatikainstituut, Department of Informatics
Instituudi direktor Rein Kuusik

- Informaatika aluste õppetool, Chair of Foundations of Informatics, Rein Kuusik
- Infosüsteemide õppetool, Chair of Information Systems, Erki Eessaar
- Infoturbe õppetool, Chair of Information Security, Ahto Buldas
- Tarkvaratehnika õppetool, Chair of Software Engineering, Kuldar Taveter
- Teadmussüsteemide õppetool, Chair of Knowledge-Based Systems, Jaak Tepandi

2. **Instituudi teadus- ja arendustegevuse (edaspidi T&A) iseloomustus**
(NB! punktid 2.1- 2.6 täidab struktuuriüksus)

2.1 struktuuriüksuse koosseisu kuuluvate uurimisgruppide
2.1.1 teadustöö kirjeldus *(inglise keeles*);

The research work performed at the department in 2012 was performed by the following, partially overlapping, informal research laboratories and research groups. We will next shortly characterise each of the research groups and laboratories:

- Research Group of Information Systems (Mart Roost, Karin Rava, Lea Elmik, Dr Enn Õunapuu, Tarmo Veskioja, Ingrid Pappel, Ingmar Pappel). The research work by this group is centred on the government-funded project by the department "Model-based Creation and Management of Evolutionary Information Systems". The goal of the project is to create a method for developing information systems that evolve in an evolutionary way jointly with businesses by means of constant development. We intend to achieve this goal by investigating and applying collaborative information systems' development by their users and developers. We take an approach of socio-technical systems that combines five research topics represented at the Department of Informatics: information systems self-development (led by Mart Roost), archetypes-based software engineering (led by Dr Gunnar Piho, please see also Research Group of Archetypes Based Software Factories for Evolving Systems), data mining (led by Dr Innar Liiv, please see also Industrial Data Mining Laboratory), service-oriented architectures (led by Dr Enn Õunapuu, please see also Laboratory of Web Services and Sensor Networks), and agent-oriented modelling (led by Prof Kuldar Taveter, please see also Laboratory of Socio-Technical Systems).
- Research Group of Archetypes Based Software Factories for Evolving Systems (Gunnar Piho, Jaak Tepandi, Viljam Puusep, Stanislav Vassiljev). This research group investigates archetypes based techniques for domains, requirements and software, integrated as a software factory, evolving together with the business processes, enhancing the dependability of resulting systems, and using collaborative system development by their users and

developers. A software factory is a domain specific Rapid Application Development environment that applies traditional manufacturing techniques and principles to software development and captures a configuration of languages, patterns, frameworks, and tools. The evolving systems aspects of the proposed project are aligned with the government-funded project by the department "Model-based Creation and Management of Evolutionary Information Systems".

- Research Group of Databases (Erki Eessaar, Rünno Sgirka, Mart Karu). The main line of research in this group is finding novel ways to support the work of database designers and helping them to select the best database design from a set of possible designs in the given context.
- Industrial Data Mining Laboratory (Dr Innar Liiv, Rein Kuusik, Grete Lind, Rain Öpik, Ermo Täks, Jaan Übi, Anton Vedeshin, Ants Torim, Tarvo Treier, Ott Lepik). This research lab develops industry-focused technologies and solutions to make sense of vast amounts of data. The strategic goal of the lab is to excel equally in teaching, research, and consulting on data mining topics. One of the methods used by the lab in this research area is the method of monotone systems, which has been developed at the department over three decades. Currently the method is being adapted for data mining and analysis of very large data sets.
- Research Group of Computational Linguistics (Professor Emeritus Leo Võhandu, Kairit Sirts, Ahti Lohk, Ottokar Tilk, Andre Veski) has been productive in the field of multidimensional scaling of large matrixes and tensors. The research group has created and applies a novel unifying method for solving three NP-hard tasks: multidimensional scaling, obtaining minimal crossing number in binary graphs, and graph bandwidth minimising.
- Laboratory of Web Services and Sensor Networks (Dr Enn Õunapuu, Kristo Klesment, Irina Kelder, Viljam Puusep, Einar Polis). The goal of the laboratory is to develop solutions for the era of IoT (Internet of Things). Main components of these solutions are smart devices, processes, and services. For the students we have developed a course „Internet of Things Solutions: Smart Devices, Processes, and Services". The research lab has focused on application-oriented research projects in the field of IoT related to e-billing, power engineering, etc.
- Laboratory of Socio-Technical Systems (Prof Kuldar Taveter, Inna Shvartsman, Kristi Kirikal, Tanel Tenso, Msury Mahunnah, Andrus Kanarbik, Raino Kolk). The lab focuses on software engineering methods for designing systems that support humans in their everyday activities. Such systems include educational (training) systems, intelligent digital assistants for social networking services, systems for simulating real-world phenomena, and systems for individualised healthcare and smart home and office.

2.1.2 aruandeaastal saadud tähtsamad teadustulemused *(inglise keeles)*

We will now present most important research results achieved in 2012 by the respective research groups and laboratories:

- Research Group of Information Systems. This research group has focused on the research project "Model-based Creation and Management of Evolutionary Information Systems" funded by the Estonian Ministry of Education and Research. According to the project plan, in 2012 the group started jointly with the Laboratory of Web Services and Sensor Networks

with designing and implementing a tool for enterprise information systems development targeted at SMEs, where information systems development and evolution occur through developing various models at the business level, such as models of goals and business rules, and organisation model. The tool will support the development of model-based information systems based on the unified methodology of developing evolutionary information systems worked out in the project. In the proof-of-concept prototype that is being developed, a business process model connects over a web service to the body of business rules determining the logic of the business process. This kind of solution well supports the evolution of an information system because it enables to change the business rules underlying a business process at any time, independently of the business process itself.

- Research Group of Archetypes Based Software Factories for Evolving Systems. The most important research results in 2012 were further development of the archetypes based process design methodology and a comparison of the opportunities provided by the RAISE specification language and the C-SHARP language for the specification of domain models.

- Research Group of Databases. In 2012 a journal paper (with the 1.1 classification) was published, which presented a decision support method for evaluating the appropriateness of different database designs (design alternatives) for a given context. The method is based on the Analytical Hierarchy Process and uses pairwise comparisons. In addition, we investigated the use of database design patterns to facilitate the specification and implementation of complex integrity constraints. A prototype of a supporting tool was developed (http://staff.ttu.ee/~eessaar/SQL_profile/). It is important that M.Sc. students (M. Soobik, E. Aaberg) and a B.Sc. student (S. Beljakov) were involved in this work because it offered them experience in scientific research. In addition, it was investigated how to employ "antipatterns" to automate the detection of design problems in SQL databases by using queries based on the catalogues of databases. The resulting publication will appear in 2013.

- Industrial Data Mining Laboratory. Last year a remarkable share of the research work by this lab was devoted to the project of analysing the usability of electric vehicles and the car behaviour data in Estonia in collaboration with the Mitsubishi Corporation, which signed a research agreement with Tallinn University of Technology in 2012. Industrial Data Mining Lab is responsible for the project's management and actual applied data mining research. Lab is also supervising research by tens of M.Sc. students, most of whom are assigned to different research subtasks of the project. In November of 2012 the research staff and students of the lab visited Mitsubishi Corporation in Tokyo to present the interim results and receive customer feedback. Experience from the industrial project will be used to shape teaching of data mining at the department and for publishing the novel scientific solutions after the completion of the project in 2013. The experience will also be utilised in the the government-funded project by the department "Model-based Creation and Management of Evolutionary Information Systems". In addition, researchers of the lab have undertaken teaching assignments in four Chinese universities on the topics of optimisation modelling and social network analysis. In 2012 an earlier research internship by our PhD student Jaan Übi at the University of Georgia resulted in a reciprocal visit and cooperation between the University of Georgia, USA, and Estonian Competence Centre for Cancer Research. In 2012 initial contacts with Salisbury University, USA, led to short teaching stints in both universities to be followed by extended visits to our university by the faculty members of

Salisbury University in 2013. Seven new courses have been introduced in the M.Sc. and PhD. programs in business, logistics and healthcare studies. These courses are concerned with data mining and analysis, decision analysis and management science, and application of the ICT. The lab had a two visiting researchers in 2012: Luca Curella from Università degli Studi di Verona and Juan Cui from University of Georgia.

- Research Group of Computational Linguistics. The group continued in 2012 with investigating efficient methods for multidimensional scaling of large matrixes and tensors with 0/1 elements. A method and prototypical program for trimming sparse matrixes were developed, enabling to solve in seconds the following NP-complete tasks: multidimensional scaling, obtaining minimal crossing number in binary graphs, and graph bandwidth minimising. This work has been reported in the M.Sc. thesis by Ottokar Tilk. Two PhD students worked for extended periods abroad. First, Kairit Sirts spent the first quarter of the year at the University of Edinburgh, UK, where she formally generalised a morphological parser for Estonian. Towards the end of the year, Ahti Lohk worked for 4 months at Princeton University, USA, where he analysed structural inconsistencies in the famous WORDNET system by Princeton University by employing the methods worked out at our department. Both visits will lead to joint papers to be written with the respective mentors of the PhD students S. Goldberg and C. Fellbaum.

- Laboratory of Web Services and Sensor Networks. The research work in this research group was centred on two innovation shares by Enterprise Estonia. One of them addressed automation of accounting for SMEs by creating an adjustable and adaptive prototypical rule-based software agent for accounting. Another innovation share dealt with developing methods for data analysis and decision-making for improving performance in various areas of sports. In 2012 a new course "Internet of things: smart devices, processes and services" was initiated by the lab. The lab also contributed to the government-funded project by the department "Model-based Creation and Management of Evolutionary Information Systems".

- Laboratory of Socio-Technical Systems. In 2012 the lab has continued research work on developing distributed information systems where information is collected, processed, and shared by distributed nodes that are peers to each other. Jointly with the University of South Carolina, USA, the methodology was created and the case studies for engineering such information systems were conducted in the areas of healthcare and grocery shopping. The areas where societal information systems can help are regulation, allocation of scarce re-sources, distributed situation assessment, system control, and decentralised decision-making, which represent five kinds of problems that societies confront. The link to the the government-funded project by the department "Model-based Creation and Management of Evolutionary Information Systems" is that societal information systems largely evolve "naturally", due to the changes in the information perceived at different nodes of the information system. In addition to that, a societal information system is also developed in a distributed fashion. This means that users of the information system as developers can tune certain parameters of the information system, determining which information is to be collected and how it is to be processed. Also, each agent (actor) playing some role in an organisation should be able to adapt the instance of the role to the agent's particular needs. In 2012 the lab participated in the networking project by the EU (COST Action) "Agreement Technologies". Within the project, Prof Kuldar Taveter paid a two weeks' research visit to

Swinburne University of Technology in Melbourne, Australia. The lab hosted for two months a visiting researcher Eva Zupancic, PhD student at the Faculty of Computer and Information Science, University of Ljubljana, Slovenia. Also, within the same project, the PhD student Msury Mahunnah spent five weeks working with Prof. Dr. Michael Ignaz Schumacher at the Applied Intelligent Systems Laboratory of the University of Applied Sciences Western Switzerland, Sierre (HES-SO). We also worked towards designing and implementing a tool for agent-oriented modelling. In this area, the M.Sc. student A. Rybinski created an ontology describing agent-oriented modelling as a domain in domain-specific modelling, thereby extending and improving the original ontological foundations of agent-oriented modelling. The B.Sc. student A. Sapoznikov implemented a part of the ontology as a proof-of-concept prototype of the tool. In 2012 the lab started participation in the project by the EU 7th Framework "Modelling crisis management for improved action and preparedness" (CRISMA). Last year, agent-oriented modelling was used for requirements engineering in the project (Prof Kuldar Taveter, Tanel Tenso).

2.2 Uurimisgrupi kuni 5 olulisemat publikatsiooni läinud aastal.

Eessaar, E; Soobik, M. (2012). A Decision Support Method for Evaluating Database Designs. Computer Science and Information Systems, 9(1), 81 - 106. Klassifikatsioon 1.1.

Lohk, A.; Võhandu, L. (2012). Eesti wordnet'i struktuuri analüüsist. Eesti Rakenduslingvistika Ühingu Aastaraamat, 8, 139 - 151. Klassifikatsioon 1.1.

Taveter, K.; Du, H.; Huhns, M. N. (2012). Engineering societal information systems by agent-oriented modeling. Journal of Ambient Intelligence and Smart Environments, 4(3), 227 - 252. Klassifikatsioon 1.1.

Liiv, I.; Öpik, R.; Übi, J.; Stasko, J. (2012). Visual matrix explorer for collaborative seriation. Wiley Interdisciplinary Reviews: Computational Statistics, 4(1), 85 - 97. Klassifikatsioon 1.2.

Piho, G.; Tepandi, J.; Roost, M. (2012). Archetypes Based Techniques for Modelling of Business Domains, Requirements and Software. Henno, J.; Kiyoki, Y.; Tokuda, T.; Jaakkola, H.; Yoshida, N. (Toim.). Information Modelling and Knowledge Bases XXIII (219 - 238). IOS Press. Klassifikatsioon 3.1.

2.3 Loetelu struktuuriüksuse töötajate rahvusvahelistest tunnustustustest.

Kuldar Taveter, anti nimetus Adjunct Professor, Swinburne University of Technology, Melbourne, Australia

2.4 Loetelu struktuuriüksuse töötajatest, kes on välisakadeemiate või muude oluliste T&A-ga seotud välisorganisatsioonide liikmed.

1. Enn Õunapuu; Association for Computing Machinery (ACM); Liige
2. Enn Õunapuu; Institute of Electrical and Electronics Engineers (IEEE); Liige
3. Enn Õunapuu; IARIA scientific committee member of the Journal Editorial Board
4. Mart Roost; IFIP WG8.2 Information Systems and Organizations töögrupi liige

2.5 Aruandeaasta tähtsamad T&A finantseerimise allikad.

Allikas	Projekti nimetus	Projekti juht/ raha saaja	Ajavahemik	Summa, €
EITSA	Bioinformaatika alaste loengute korraldamine ja kontaktide loomine	Jaan Übi	12.05.2012 - 12.06.2012	1700
EITSA	Toetus osalemiseks konverentsil 6th WSEAS	Deniss Kumlander	22.09.2012 - 27.09.2012	1000
EITSA	Toetus osalemiseks konverentsil ICEIS 2012	Grete Lind	27.06.2012 - 02.07.2012	1091,77
Doktorikool	Toetus osalemiseks konverentsil 6th International Global Wordnet Conference	Ahti Lohk	07.01.2012 - 15.01.2012	1696
Kristjan Jaak	Toetus osalemiseks konverentsil 6th International Global Wordnet Conference	Ahti Lohk	07.01.2012 - 15.01.2012	
EITSA	Toetus osalemiseks konverentsil „European Chapter of the Association of Linguistic Patterns and Uncovering Language History from Multilingual Resources“ (EACL 2012)	Ahti Lohk	22.04.2012 – 25.04.2012	915,93
DoRa 8	Toetus osalemiseks suvekoolis "2012 International Summer School in Language and Speech Technologies"; Hispaania, Tarragona	Ahti Lohk	29.07.2012 - 04.08.2012	1055
Doktorikool	Toetus osalemiseks suvekoolis Business Model Innovation	Arvo Sulakatko	23.07.2012 – 27.07.2012	730
DoRa8	Toetus osalemiseks konverentsil i-Society 2012	Ingrid Pappel	23.06.2012 – 28.06.2012	1422
DoRa8	Toetus osalemiseks konverentsil IADIS Conference Applications and Research 2012	Ingmar Pappel	16.07.2012 – 23.07.2012	1548

2.6 Soovi korral lisada aruandeaastal saadud T&A-ga seotud tunnustusi (va punktis 2.3 toodud tunnustused), ülevaate teaduskorralduslikust tegevusest, teadlasmobiilsusest ning anda hinnang oma teadustulemustele.

Teaduskorralduslik tegevus:

1. Jaak Tepandi; ajakirja "Applied Computer Systems" retsensent
2. Jaak Tepandi; osavõtt Vabariigi Presidendi ajurünnakutest seoses infoühiskonna rahvusvahelise mõtte- ja kompetentsikeskuse loomisega Eestisse
3. Jaak Tepandi; rahvusvahelise konverentsi NordSec 2012 programmkomitee liige

4. Jaak Tepandi; Euroopa Võrgu- ja Infoturbe Agentuuri (ENISA) nõukogu Eesti poolne asendusliige
5. Jaak Tepandi; Eesti Infotehnoloogia standardimise tehnilise komitee esimees
6. Innar Liiv; kursuse korraldamine; “Knowledge Discovery, Visual Analytics and Innovation in Social Computing”; Macau University of Science and Technology, Hiina; 03.11-08.11.2012
7. Innar Liiv; kursuse korraldamine; "Knowledge Discovery, Visual Analytics and Innovation in Social Computing”; University of Science and Technology Beijing, Hiina; 12.10.-20.10.2012
8. Innar Liiv; ajakirja Computational Statistics & Data Analysis (Elsevier) retsensent, retsenseeris 2 artiklit
9. Innar Liiv; ettekanne „Seriation, Clustering and Related Research in Estonia: Towards an Encyclopedia of Structures“ Tama Ülikoolis, Jaapan, 19.11.2012
10. Enn Õunapuu; konverentsi BUSTECH 2012 orgkomitee
11. Jaak Henno; rahvusvahelise konverentsi programmkomitee; the Jubilee 35th International Convention MIPRO 2012; refereeris 5 ettekannet
12. Jaak Henno; rahvusvahelise konverentsi programmkomitee; the 22nd European Japanese Conference on Information Modelling and Knowledge Bases; refereeris 4 ettekannet
13. Mati Tombak; rahvusvahelise konverentsi Pattrerns 2012 programmkomitee liige, retsenseeris 1 artiklit
14. Mati Tombak; Eesti Matemaatika Seltsi liige
15. Leo Võhandu; 1.1 kategooria väljaande Estonian Papers in Applied Linguistics Advisory Board liige; retsenseeris 3 artiklit
16. Leo Võhandu; Eesti Statistika Seltsi auliige
17. Leo Võhandu; TLÜ informaatikaalaste magistritööde kaitsmiskomisjoni esimees (juuni 2012)
18. Rein Kuusik; Scientific Proceedings of Riga Technical University, Toimetuse (editorial board) liige, retsensent (1 artikkel)
19. Rein Kuusik; rahvusvahelise konverentsi ISD 2012 programmkomitee liige, retsenseeris 3 artiklit
20. Jaan Übi; bioinformaatika alaste loengute korraldamine ja kontaktide loomine, University of Georgia, Computational and Systems Biology Lab; USA; 12.05.-12.06.2012
21. Kuldar Taveter, Euroopa Liidu COST-programmi võrgustumisprojekti “Agreement Technologies” (Action IC0801) juhtkomitee liige.
22. Kuldar Taveter, rahvusvahelise konverentsi „13th International Workshop on Agent-Oriented Software Engineering“ (AOSE 2012) programmkomitee liige, retsenseeris 3 artiklit.
23. Kuldar Taveter, rahvusvahelise konverentsi „Federated Computer Science and Information Systems Conference“ (FedCSIS 2011) programmkomitee liige, retsenseeris 1 artikli.
24. Kuldar Taveter, rahvusvahelise konverentsi „Agreement Technologies 2012“ (AT 2012) programmkomitee liige, retsenseeris 5 artiklit.

Teadlasmobiilsus:

1. Leo Võhandu; esinemine Eesti Rakenduslingvistika Ühingu kevadkonverentsil, Tallinn, Eesti, 26.04.-27.04. 2012.
2. Leo Võhandu; esinemine Eesti Statistika Seltsi konverentsil, Tartu, Eesti, september 2012.
3. Jaak Henno; osalemine konverentsil the Jubilee 35th International Convention MIPRO 2012, 21.05.-25.05.2012, Opatija, Horvaatia; ettekanne; ettekande põhjal toimus konverentsil ka samateemaline ümarlaua istung, kus tegi avaettekande.
4. Jaak Henno; osalemine konverentsil the 22nd European Japanese Conference on Information Modelling and Knowledge Bases; Praha, Tšehhi; 04.06.-09.06.2012; 1 ettekanne.
5. Gunnar Piho; osalemine konverentsil the 22nd European Japanese Conference on Information Modelling and Knowledge Bases; Praha, Tšehhi; 04.06.-09.06. 2012; 1 ettekanne.
6. Innar Liiv; osalemine konverentsil 8th International Conference of DAAAM Baltic Industrial Engineering, Tallinn, Eesti, 19.04.-21.04.2012.
7. Grete Lind; osalemine konverentsil the 14th International Conference on Enterprise Information Systems (ICEIS); Wrocław, Poola; 28.06.–01.07.2012; 1 ettekanne.
8. Deniss Kumlander; osalemine konverentsil 6th WSEAS European Computing Conference (ECC'12), Praha, Tšehhi, 24.09.-26.09. 2012; 2 ettekannet.
9. Deniss Kulmander; osalemine konverentsil International Joint Conferences on Computer, Information, and Systems Sciences, and Engineering (CISSE 2012) – virtuaalne konverents; 2 ettekannet.
10. Erki Eessaar; osalemine konverentsil International Joint Conferences on Computer, Information, and Systems Sciences, and Engineering (CISSE 2012) – virtuaalne konverents; 1 ettekanne.
11. Kristina Murtazin; osalemine konverentsil International Joint Conferences on Computer, Information, and Systems Sciences, and Engineering (CISSE 2012) – virtuaalne konverents; 1 ettekanne.
12. Rain Öpik ja Jaan Übi; kursuse läbiviimine; “Knowledge Discovery, Visual Analytics and Innovation in Social Computing”; Macau University of Science and Technology, Hiina; 03.11-08.11. 2012.
13. Rain Öpik ja Jaan Übi; kursuse läbiviimine; "Knowledge Discovery, Visual Analytics and Innovation in Social Computing”; University of Science and Technology Beijing, Hiina; 12.10.-20.10. 2012.
14. Ahti Lohk; osalemine konverentsil 6th International Global Wordnet Conference; Matsue, Jaapan; 09.01.-13.01.2012; 1 ettekanne.
15. Ahti Lohk; osalemine konverentsil EACL 2012 Joint Workshop of LINGVIS & UNCLH; Avignon, Prantsusmaa; 23.04.-24.04.2012; 1 ettekanne.
16. Ahti Lohk; stažeerimine Princetoni Ülikooli Arvutiteaduse Instituudis; 18.09.2012 - 20.01.2013 (125 päeva).

17. Kairit Sirts; osalemine konverentsil the 2012 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies; Montréal, Canada; 03.06.-08.06.2012; 1 ettekanne.
18. Ingrid Pappel; osalemine konverentsil International Conference on Information Society (i-Society 2012)/ Infonomics Society; London, Suurbritannia; 25.06.-28.06.2012; 1 ettekanne.
19. Ingmar Pappel; osalemine konverentsil IADIS International Conference Internet Applications and Research 2012, Lissabon, Portugal; 17.07–19.07.2012; 2 ettekannet.
20. Ingmar Pappel; osalemine konverentsil IADIS International Conference e-Society 2012; Berliin, Saksamaa; 10.03.-13.03.2012; 1 ettekanne.Nazmun Nahar; osalemine konverentsil PICMET'12 Conference „Technology Management for Emerging Technologies", Vancouver, Canada, 29.07.-02.08.2012; 1 ettekanne.Anton Karputkin; osalemine konverentsil 13th International Symposium on Quality Electronic Design (ISQED), Santa Clara, CA, USA, 19.03.-21.03.2012; 1 ettekanne.
21. Kuldar Taveter; teaduslik lähetus Euroopa Liidu COST-programmi võrgustumisprojekti "Agreement Technologies" (Action IC0801) raames – Swinburne University of Technology, Melbourne, Austraalia. Koostöölepingu sõlmimine Swinburne Tehnikaülikooli ja TTÜ vahel, ühine uurimistöö Prof Leon Sterlingiga, kohtumised mitmete kolleegidega ja 1 ettekanne.

Hinnang

1) Instituudi nõukogu koondhinnang aruandlusperioodi teadus- ja arendustööle on „väga hea" (4). Püstitatud ülesanded on valdavalt täidetud ning on saadud finantseerimine ja alustatud koos Automaatikainstituudiga osalemist EL-i 7. Raamprogrammi projektis „Kriisihalduse modelleerimine tegevuste ja valmisoleku parandamiseks" (CRISMA).

2) Võrreldes eelmise aruandlusperioodiga on teadusaktiivsus ja tulemused temaatiliselt edasi arenenud, tõsist analüüsi ja arendamist leidis sihtfinantseeritav teadusteema. Finantseerimise maht on kasvanud, seda eelkõige välislepingute kasvu arvelt. Samas ei kajasta käesolev aruanne täielikult meie töötajate teadus-arendustegevust, sest et nad osalevad ka välistes teadusprojektides (näiteks Prof Ahto Buldas osaleb Küberneetika instituudi ETF grantides ja AS Cybernetika projektides, mis pole registreeritud meie teadusteemadena).

Rahalises väljenduses on viimase viie aasta dünaamika järgmine.

	2008 (EEK)	**2009 (EEK)**	**2010** (EEK/EUR)	**2011**	**2012**
Põhiteema	-	-	1 508 900/96400	92700	82400
Baasfinantseerimine	1 230 000	1 425 600	-	-	-
ETF grantid	140 000	168 000	-	-	-
Välisprojektid	-	-	-	-	21576
Lepingud	32400	300 800	347 400/22203	14345	9000
Individuaalsed toetused	386 310	Andmed puuduvad	Andmed puuduvad	9921	11383
Õppearendustegevuse	140 030	35 000	63 000/4026	50600	40500

projektid					
Kokku	**1 928 740**	**1929400**	**1919300/122165**	**162866**	**164859**

3) Publitseerimise seisukohalt tuleb aastat lugeda heaks – 38 RV (1.1 kuni 3.2) kõrgtaseme artiklit olukorras, kus neid lisaks põhikohaga teaduritele toodavad regulaarselt ka teaduskohustuslikud õppejõud, on hea tulemus (keskmiselt 1,4 artiklit iga teaduskohustusliku õppejõu ja teaduri kohta). Artiklite tootmise protsess on stabiliseerunud (suur osa selle aasta sügiskonverentside publikatsioone, mis aruandes ei kajastu, ilmuvad 2013. aastal) ja arvestades suurt õppetöö koormust on raske paremat nõuda. Samas on olemas veel kasutamata reserve suurema rühma kaasautorite ühisartiklite ja doktorantide aktiivsema tegutsemise näol. Lahendamata on, ja arvatavasti jääbki lahendamata, 3.2 artiklite staatus, kus tegu on valdkonna olulisimate konverentsidega, mis aga kahjuks ei kajastu ISI Thompsoni andmebaasides.

4) Kaitsti üks, vanemteadur Mati Tombaku poolt kaasjuhendatud doktoritöö (Anatoli Karputkin). Kaitsmiste arv on küll väiksem kaitsmiste arvust eelmisel aastal, aga juba 2013. aastal on oodata 5 kaitsmist (Ingrid Pappel, Ermo Täks, Einar Polis, Jaan Übi, Inna Shvartsman).

5) Instituudi juurde kuuluva mitteformaalse struktuurina töötab „Tööstusliku andmekaeve labor“ (juht dots. Innar Liiv), mille raames teostati punkti 2.1 all kirjeldatud projekt Mitsubishiga. Lisaks teeb labor koostööd Georgia Ülikooliga ja Salisbury Ülikooliga USA-s ning Università degli Studi di Veronaga Itaalias.

6) Instituudi juurde kuuluva mitteformaalse struktuurina töötab „Sotsiotehniliste süsteemide labor“ (juht Prof Kuldar Taveter), mille raames osaleti 2012. aastal Euroopa Kaitseagentuuri projektis “Asymmetric threat environment analysis” (ATHENA) ja Euroopa Liidu COST-programmi võrgustumisprojektis “Agreement Technologies” (Action IC0801) ning märtsikuus alustati osalemist EL-i 7. Raamprogrammi projektis „Kriisihalduse modelleerimine tegevuste ja valmisoleku parandamiseks“ (CRISMA). Lisaks teeb labor koostööd Swinburne Tehnikaülikooliga Austraalias, Lõuna Carolina Ülikooliga USA-s ning Lääne-Sveitsi Rakendusteaduste Ülikooliga Sierres (HES-SO).

7) Instituudi juurde kuuluva mitteformaalse struktuurina on käivitatud „Veebiteenuste ja sensorvõrkude labor“ (juht vanemteadur Enn Õunapuu), mille raames teostati 2012. aastal 2 EAS innovatsiooniosakut ja osaleti aktiivselt instituudi sihtfinantseeritavas teadusteemas. Aastal 2012 alanud IT Akadeemia võimaldab sisustada selle labori vajalike sensorvahenditega.

8) Saadi finantseerimine ja alustati koos Automaatikainstituudiga osalemist EL-i 7. Raamprogrammi projektis „Kriisihalduse modelleerimine tegevuste ja valmisoleku parandamiseks“ (CRISMA). Lisaks osalesime akadeemilisel aastal 2011/12 kolmes taotluses, millest üks (vanemteadur E. Õunapuu osalusel koostatud) EL-i projektitaotlus said EL-i finantseeringu alates aastast 2012, kuid EAS keeldus finantseerimast Eesti osapooli. Instituudi osalusel esitati 2 EAS-i innovatsiooniosakuga seotud arendustaotlust. Jätkus Haridus- ja Teadusmisteeriumi projekti ”Loodus- ja täppisteaduste ning tehnoloogia (LTT) valdkonna gümnaasiumi valikkursuste õppekomplektid“ valikkursuse “Rakenduste loomise ja programmeerimise alused“ arendamine.

9) Vastavalt sihtfinantseeritava teadusteema projektiplaanile on 2012. aastal alustatud infosüsteemide evolutsioonilise arendamise ühtse metodoloogia põhjal mudelitest tarkvara genereeriva süsteemi loomisega. Seda käsitleb üks kaitstud doktoritöö (Gunnar Piho, detsember

2011) ja rida teisi teaduspublikatsioone. Oleme kavandanud vastava arendusprojekti ja taotleme lisafinantseerimist ELilt. Sihtfinantseeritav projekti raames realiseerime hetkel moodulit, mis toob ärireeglid äriprotsessi mudelist välja. Loodavas prototüübis võtab protsessi mudel reeglitega ühendust läbi veebiteenuse. Niisugune lahendus toetab hästi evolutsioneeruvust, sest võimaldab otsustuste aluseks olevate ärireeglite muutmist sõltumata vastavast äriprotsessist. Käeoleval aastal on teadus- ja arendustegevuse üheks põhieesmärgiks eelmisel aastal alustatud prototüüpimise lõpuleviimine. Samas sihtfinatseeritavas teadusprojektis on andmekaeve töörühm (juht dots. Innar Liiv) arendanud erinevaid struktuursete mustrite kaevandamise algoritme, kus mustrid koosnevad infosüsteemi logides registreeritud sündmustest. Meie arendatud mustrite avastamise algoritmide tõhusust katsetame koostöös Mitshubishiga äriprotsesside kaevandamisel. Evolutsioneeruvuse teoreetiliste aluste töörühm (juht vanemteadur Mati Tombak) on uurinud superpositsioonilisi graafe, mis on ekspressiivsed formalismid ärireeglite esitamiseks. Alustasime EL-i projektiga CRISMA, kus mh uurime evolutsioneeruvust projektis loodavas kriiside simulatsiooni infosüsteemis.

10) Jätkuvalt toimuvad sihtfinantseerimise teemalised regulaarsed töögruppide aruandeseminarid ja iganädalased instituudi siseseminarid. Arvestades nendele juurde 2 iganädalast doktoriseminari, toimub instituudis pea igal nädalal 4 teadusseminari. Stabiilseks peab muutuma nelja doktoritöö kaitsmine aastas, ka ootaks juba kaitsnud doktorite läbimurret rahvusvahelisele tuntusele oma teadustöös (Innar Liiv, Erki Eessaar, Ants Torim). Kuigi instituudi akadeemiline personal on veel suhteliselt noor (keskmine vanus 46 aastat), on juba mitmeid pensioniikka jõudnud õppejõude. Kuna on ette näha sihtfinantseeritava teadusteema (töö)mahu olulist kasvu ja veelgi enamate rahvusvaheliste projektide tulekut, on tarvis kasvatada teadurite arvu. Lähtudes viie aasta noorte doktorite vajadusest, on endiselt oluline uue teaduspersonali ja õppejõudude järelkasvu tagamine. Selleks avas head võimalused 2012. aastal käivitunud IT Akadeemia koos EL-i projektidega.Instituudi akadeemilise personali strateegia aastani 2015 on esitatud TTÜ personaliosakonda.

2.7 Instituudi teadus- ja arendustegevuse teemade ja projektide nimetused *(Eesti Teadusinfosüsteemi, edaspidi ETIS, andmetel)*

- Haridus- ja Teadusministeerium

– sihtfinantseeritavad teemad:

T013, Evolutsioneeruvate infosüsteemide mudelipõhine loomine ja haldamine, Taveter Kuldar (2010 – 2014)

– baasfinantseerimise toetusfondist rahastatud projektid (sh TTÜ tippkeskused):
– riiklikud programmid:

- Teiste ministeeriumide poolt rahastatavad riiklikud programmid:

- Uurija-professori rahastamine:

- SA Eesti Teadusfond/Eesti Teadusagentuur

– grandid:
– ühisgrandid välisriigiga:
– järeldoktorite grandid (SA ETF ja Mobilitas):

- tippteadlase grandid (Mobilitas):
    - Ettevõtluse Arendamise SA
- eeluuringud:
- arendustoetused:
    - SA Archimedesega sõlmitud lepingud
- infrastruktuur (nn „mini-infra“, „asutuse infra“):
- Eesti tippkeskused:
- riiklikud programmid:
- muud T&A lepingud:

- SA Keskkonnainvesteeringute Keskusega sõlmitud lepingud:
- Siseriiklikud lepingud:
- EL Raamprogrammi projektid:

VFP544, Kriisihalduse modelleerimine tegevuste ja valmisoleku parandamiseks (CRISMA), Taveter Kuldar (1.03.2012 - 31.07.2015)

- Välisriiklikud lepingud:

2.8 Struktuuriüksuse töötajate poolt avaldatud eelretsenseeritavad teaduspublikatsioonid *(ETIS klassifikaatori alusel 1.1, 1.2, 1.3, 2.1, 2.2, 3.1, 3.2, 3.3, 4.1 ja 5.1).*

1.1

Eessaar, E; Soobik, M. (2012). A Decision Support Method for Evaluating Database Designs. Computer Science and Information Systems, 9(1), 81 - 106.

Lohk, A.; Võhandu, L. (2012). Eesti wordnet'i struktuuri analüüsist. Eesti Rakenduslingvistika Ühingu Aastaraamat, 8, 139 - 151.

Taveter, K.; Du, H.; Huhns, M. N. (2012). Engineering societal information systems by agent-oriented modeling. Journal of Ambient Intelligence and Smart Environments, 4(3), 227 - 252.

1.2

Jaakkola, H.; Linna, P.; Henno, J.; Mäkelä, J.; Welzer-Druzovec, T. (2012). A path towards networked organisations – the push of digital natives or the pull of the needs? International Journal of Knowledge Engineering and Soft Data Paradigms, 3(3/4), 240 - 260.

Liiv, I.; Öpik, R.; Übi, J.; Stasko, J. (2012). Visual matrix explorer for collaborative seriation. Wiley Interdisciplinary Reviews: Computational Statistics, 4(1), 85 - 97.

1.3

2.1

2.2

3.1

Laansalu-Veskioja, K., Veskioja, T. (2012). A Small Experiment on Mining Memeplexes. Kiyoki, Y.; Tokuda, T.; Henno, J.; Jaakkola, H.;Yoshida, N. (Toim.). Information Modelling and Knowledge Bases XXIII (344 - 351). Amsterdam: IOS Press

Torim, A. (2012). A Visual Model of the CRUD Matrix. Kiyoki, Y.; Tokuda, T.; Henno, J.; Jaakkola, H.; Yoshida, N. (Toim.). Information Modelling and Knowledge Bases XXIII (313 - 320). Amsterdam: IOS Press

Piho, G.; Tepandi, J.; Roost, M. (2012). Archetypes Based Techniques for Modelling of Business Domains, Requirements and Software. Henno, J.; Kiyoki, Y.; Tokuda, T.; Jaakkola, H.; Yoshida, N. (Toim.). Information Modelling and Knowledge Bases XXIII (219 - 238).IOS Press

Nahar, N.; Huda, N.; Tepandi, J. (2012). Critical risk factors in business model and IS innovations of a cloud-based gaming company: Case evidence from Scandinavia. 2012 Proceedings of PICMET '12: Technology Management for Emerging Technologies (PICMET'12) (3674 - 3680).IEEE

Argente, E.; Boissier, O.; Esparcia, S.; Görmer, J.; Kirikal, K.; Taveter, K. (2012). Describing Agent Organisations. S. Ossowski et al. (Toim.). Handbook on Agreement Technologies (3 - 25).Springer [ilmumas]

Argente, E.; Billhardt, H.; Cuesta, C.; Esparcia, S.; Görmer, J.; Hermoso, R.; Kirikal, K.; Lujak, M.; Perez-Sotelo, J. S.; Taveter, K. (2012). eAdaptive Agent Organisations. Sascha Ossowski et al. (Toim.). Handbook on Agreement Technologies (69 - 100).Springer [ilmumas]

Hashimoto, T.; Henno, J.; Jaakkola, H.; Sasa, A.; Thalheim, B. (2012). Infrastructures for Knowledge System Environments. Information Modelling and Knowledge Bases XXIII (369 - 398). Amsterdab: IOS Press

Võhandu, L.; Peder, A.; Tombak, M. (2012). Permutations and Bijections. Jaak Henno, Yasushi Kiyoki, Takehiro Tokuda, Hannu Jaakola, Naofumi Yoshida (Toim.). Information Modelling and Knowledge Bases XXIII (419 - 437).IOS Press

Sirts, Kairit; Alumäe, Tanel (2012). A hierarchical Dirichlet process model for joint part-of-speech and morphology induction. In: NAACL HLT 2012 : The 2012 Conference of the North American Chapter of the Association for Computational Linguistics: Human Language Technologies, Proceedings of the Conference, June 3-8, 2012, Montréal, Canada: June 4-6, Montreal, Canada. Stroudsburg, PA: Association for Computational Linguistics, 2012, 407 - 416.

Kuusik, R.; Lind, G. (2012). An Effective Inductive Learning Algorithm for Extracting Rules. In: Proceedings of the 2011 2nd International Congress on Computer Applications and Computational Science: CACS 2011, Bali, Indonesia, November 15-17, 2011. (Toim.) Gaol, F. L.; Nguyen, Q. V.. Berlin Heidelberg: Springer-Verlag, 2012, (Advances in Intelligent and Soft Computing; 145), 339 - 344.

Lind , G.; Kuusik, R. (2012). An Idea for Universal Generator of Hypotheses. In: Proceedings of ICEIS 2012 : the 14th International Conference on Enterprise Information Systems, Volume 1, Wrocław, Poland, 28 June – 1 July. (Toim.) L. Maciaszek, A. Cuzzocrea and J. Cordeiro. Portugal: SciTePress, 2012, 169 - 174.

Karputkin, A.; Ubar, R.; Tombak, M.; Raik, J. (2012). Automated Correction of Design Errors by Edge Redirection on High-Level Decision Diagrams. In: 13th International Symposium on Quality Electronic Design (ISQED), 2012 : International Symposium on Quality Electronic Design (ISQED), Santa Clara, CA, USA, 19-21.03.2012. IEEE, 2012, 686 - 693.

Pappel, I.; Pappel, I., Saarmann, M. (2012). Digital Records Keeping to Information Governance in Estonian Local Governments. In: i-Society 2012 Proceedings: i-Society 2012, June 25-28, 2012, London, UK. (Toim.) C. A. Shoniregun, G. A. Akmayeva. London: IEEE, 2012, 199 - 204.

Eessaar, E.; Aaberg, E. (2012). Extending UML Profiles to Model Integrity Constraints in SQL Databases. In: Information Modelling and Knowledge Bases XXIII: 21st European Japanese Conference on Information Modelling and Knowledge Bases June 4-8, 2011 Tallinn, Estonia. (Toim.) Henno, J.; Kiyoki, Y.; Tokuda, T.; Jaakkola, H.; Yoshida, N.. Amsterdam: IOS Press, 2012, (Frontiers in Artificial Intelligence and Applications), 39 - 58.

Murtazin, K.; Vendelin, J. (2012). Inductive teaching approach to the course of Informatics. EIAE 2012. Springer, 2012. [ilmumas]

Taveter, K.; Du, H.; Huhns, M. N. (2012). Method for Rapid Prototyping of Societal Information Systems. In: FedCSIS 2012 Proceedings: 2012 Federated Conference on Computer Science and Information Systems (FedCSIS): Workshop on Agent Based Computing: from Model to Implementation IX (ABC:MI), Wrocław, Poland, 9 - 12 September, 2012. IEEE, 2012, 1221 - 1228.

Du, H.; Taveter, K.; Huhns, M. N. (2012). Simulating a Societal Information System for Healthcare. In: FedCSIS 2012 Proceedings: 2012 Federated Conference on Computer Science and Information Systems (FedCSIS): 6th International Workshop on Multi-Agent Systems and Simulation

(MAS&S), Wrocław, Poland, 9 - 12 September, 2012. IEEE, 2012, 1239 - 1246.

WaiShiang, Cheah; Sterling, Leon; Taveter, Kuldar (2012). Task Knowledge Patterns Reuse in Multi-Agent Systems Development. Desai, Nirmit; Liu, Alan; Winikoff, Michael (Toim.). Principles and Practice of Multi-Agent Systems 13th International Conference, PRIMA 2010, Kolkata, India, November 12-15, 2010, Revised Selected Papers (459 - 474).Springer

3.2

Piho, Gunnar; Tepandi, Jaak (2012). Business Domain Modelling with Business Archetypes and Archetype Patterns. In: Proceedings of the 22nd European-Japanese Conference on Information Modelling and Knowledge Bases, EJC2012. Prague, Czech republik, June 4-9,2012: EJC2012 Programm Commitee and EJC2012 Programm Coodination Team. , 2012, 258 - 277.

Pappel, I.; Pappel, I.; Saarmann, M. (2012). Development of information society and e-government by improving electronic records management solution at Estonian local authorities. Piet Kommmers, Pedro Isaias (Toim.). Proceedings of the IADIS International Conference e-Society 2012 (457 - 462). Berlin: IADIS Press

Murtazin, K.; Vendelin, J. (2012). Student Centred Teaching Approach for the Informatics Course . Future Computers in Education (227 - 232).Information Engineering Research Institute (IERI)

Täks, E.; Võhandu, L.; Lohk, A.; Nyman-Metcalf, K.; Rull, A. (2012). A tool for exploring the hidden structure of legislation. In: Proceedings of the fundamental concepts and the systematisation of law. Workshop at Jurix 2011 in Vienna.: JURIX 2011 The 24th International Conference on Legal Knowledge and Information Systems.. University of Vienna, 2012, 123 - 133. [ilmumas]

Tepandi, J.; Piho, G.; Puusep, V. (2012). Archetypes based development from the perspective of domain engineering research topics. In: MIPRO, 2012 Proceedings of the 35th International Convention: MIPRO 2012, Opatia (Croatia), 21-25 May 2012. MIPRO, 2012, 686 - 691.

Mironova, O.; Amitan, I.; Vilipõld, J. (2012). Computational Thinking and Flexible Learning: Experience of Tallinn University of Technology. In: Future Computers in Education: 2012 2nd International Conference on Future Computers in Education, June 1-2, 2012, Shanghai, China. Information Engineering Research Institute (IERI), 2012, (Lecture Notes in Information Technology; 23-24), 183 - 188.

Mironova, Olga; Amitan, Irina; Vilipõld, Jüri (2012). E-LEARNING IN INFORMATICS TEACHING. WWW/INTERNET 2012, Madrid, Spain, 18 – 21 October 2012. , 2012. [ilmumas]

Henno, J. (2012). Emergence of Communication and Information. In: The 22nd European Japanese Conference on Information Modelling and Knowledge Bases, Prague June 4-9, 2012: The 22nd European Japanese Conference on Information Modelling and Knowledge Bases, Prague June 4-9, 2012. Praha:, 2012, 312 - 322.

Pappel, I.; Pappel, I. (2012). Integral and secure cloud architecture based system for backup and retention of public sector information. In: Proceedings of the IADIS International Conference of Internet Applications and Research 2012: IADIS International Conference Internet Applications and Research 2012. (Toim.) M. B. Nunes, G. C. (alex) Peng, J. Roth, H. Weghorn, P. Isaias. Lisbon: IADIS Press, 2012, 105 - 110.

Kumlander, D. (2012). On Optimizing Payments Clearance Business Process – an Evolutional

Approach . In: Advances in computer science, Proceedings of the 6th WSEAS European Computing Conference (ECC'12): 6th WSEAS European Computing Conference (ECC'12), Prague, Czech Republic, September 24-26, 2012. (Toim.) S. Yenduri. WSEAS, 2012, (Recent Advances in Computer Engineering Series; 5), 505 - 510.

Henno, J.;Jaakkola, H. (2012). Quo Vadis, IT Education? In: The Jubilee 35th International Convention MIPR0 2012, May 21th-25th, Opatija, Croatia: The Jubilee 35th International Convention MIPR0 2012, May 21th-25th, Opatija, Croatia. (Toim.) P. Biljanović. Rijeka, Kroaatia: MIPRO, 2012, 1232 - 1238.

Pappel, I.; Pappel, I. (2012). The service-oriented state and local authority: service orientation in public administration. In: Proceedings of the IADIS International Conference Internet Applications and Research 2012: IADIS International Conference Internet Applications and Research 2012, Lisbon, Lisbon, Portugal, 17 - 19 July 2012. (Toim.) M. B. Nunes, G. C. Peng, J. Roth, H. Weghorn, P. Isa?as. IADIS Press, 2012, 111 - 116.

Piho, G.; Tepandi, J.; Parman, M. (2012). Towards LIMS (Laboratory Information Management Systems) software in global context. In: MIPRO, 2012 Proceedings of the 35th International Convention: MIPRO 2012, Opatia (Croatia), 21-25 May 2012. MIPRO, 2012, 721 - 726.

Kumlander, D. (2012). Uncertainty Management Framework Elements – Test Based Verification of the Process. In: Advances in computer science, Proceedings of the 6th WSEAS European Computing Conference (ECC'12): 6th WSEAS European Computing Conference (ECC'12), Prague, Czech Republic, September 24-26, 2012. (Toim.) S. Yenduri. WSEAS, 2012, (Recent Advances in Computer Engineering Series; 5), 517 - 521.

Pappel, I.; Pappel, I. (2012). Using e-learning methods in (e-)implementation of e-governance software at local governments. Case study in Estonian way. In: Advances in Digital Library Development: International Conference on Digital Libraries and Knowledge Organization ICDK 2011, Gurgaon, India, 14-16.02.2011. (Toim.) Antony Jose. Delhi: Macmillan Publishers Ltd, 2012, 413 - 419.

3.3

Luczkowski, T. (2012). Lennundusaasta 2011. Aeropress

4.1

Henno, J. (Toim, 2012). Information Modelling and Knowledge Bases XXIII. Amsterdam: IOS Press

5.1

2.9 Struktuuriüksuses kaitstud doktoriväitekirjade loetelu *(NB! struktuuriüksus lisab struktuuriüksuse töötaja juhendamisel mujal kaitstud doktoriväitekirjade loetelu)*

Anton Karputkin, doktorikraad, 2012, (juh) Jaan Raik, **Mati Tombak (informaatikainstituut)**, Raimund Ubar, Formal verification and error correction on high-level decision diagrams (Formaalne verifitseerimine ja vigade parandamine kõrgtasemelistel otsustusdiagrammidel), Tallinna Tehnikaülikool, Infotehnoloogia teaduskond, Arvutitehnika instituut

2.10 Struktuuriüksuses järeldoktorina T&A-s osalenud isikute loetelu *(ETIS-e kaudu esitatud taotluste alusel)*

2.11 Struktuuriüksuses loodud tööstusomandi loetelu

3. **Struktuuriüksuse infrastruktuuri uuendamise loetelu**

1 Sülearvuti HP Elitebook 2560p - Core i5 2410M/2.3 GHz - RAM 2 GB - HDD 320 GB
2 Sülearvuti TC/HP Elitebook 8460p NB PC, 14,0 HD with cam, UMA, i5-2410M, 320GB (4tk.)
3 Printer HP LaserJet P2055dn - B/W - duplex - laser - A4 - 1200 dpi x 1200 dpi - up to 33 ppm capasity: 300 sheets - USB, 1000Base-T