Informatics at Aalto
– a university reinvented

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ECSS 13.10.2014
1. The Aalto transformation
2. ICT at Aalto
3. Innovation and entrepreneurship
4. Key events and decisions
5. Future prospects
1. The Aalto transformation
International evaluations:
In spite of excellent university-industry collaboration and links, Finnish research and innovation system was losing ground.

Parliament passed a new Universities Bill in June 2009, enacted from Jan 2010 on

The new Universities Act extended the *autonomy* of universities in order to strengthen their role within the system of *innovation*.

Aalto University is a flagship project of the university reform. It is governed as a *private foundation*.

Aalto University
Aalto University

A merger of three complementary universities in the Helsinki region

Helsinki University of Technology, est. 1849

University of Art & Design Helsinki, est. 1871

Helsinki School of Economics, est. 1911

Endowment:
Campaign 200M€
Government 500M€
Currently ~1000 M€

Direct Government funding: PLUS 60-80 M€ pa until 2015
Aalto University Timeline

- 1849: University of Art and Design Helsinki
- 1871: Helsinki University of Technology
- 1898: Helsinki School of Economics
- 1995: Joint teaching & research programme IDBM
- 2005: Preparations for new university proposed
- 2007: Student Union formed
- 2009: President appointed
- 2010: Aalto University opens

Vision: Acknowledged world-class university
Community
• Second largest university in Finland after Univ. of Helsinki
• Over 5,000 faculty and staff, including 370 professors
• 20,000 students
• 75,000 alumni

Finances 2013
• Government budget funding 275 M€
• Supplementary (projects etc.) 143 M€
• Endowment returns 33 M€
Schools of Science*, Art, Technology* and Business

School of Arts, Design and Architecture
School of Chemical Technology
School of Business
School of Electrical Engineering
School of Engineering
School of Science

Budgets for 2014:
Science and Technology 67 %
Art, Design and Architecture 18 %
Business 15 %

*Aalto University

* Four schools were built from the former Helsinki University of Technology.
Otaniemi old Main Building, by Alvar Aalto

Entrance to CS Building
## Goal: Research excellence

Building on strengths identified in RAE 2009

<table>
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<tr>
<th>Pull</th>
<th>World class potential</th>
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<tbody>
<tr>
<td>Themes driving interdisciplinary research</td>
<td>Digital society: Mobile technologies, services, media, games, entertainment</td>
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- World class potential
  - Global business dynamics
  - Process and systems competence
  - Architecture
  - Art

- World class
  - Computation and modeling
  - ICT
  - Materials
  - Design
  - New media

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Based on extensive international research evaluation (RAE), 2009

5 National Centres of Excellence in Research
2 ERC Advanced Grants
10 ERC Starting Grants
7 Academy of Finland professors and over 35 research fellows.
Aalto is coordinator / partner in EU projects with total budgets of about 1 billion euros
Goal: Research excellence
Building on strengths identified in RAE 2009

Themes driving interdisciplinary research:
- Digital society
  - Mobile technologies, services, media, games, entertainment
- Energy & sustainable use of natural resources
  - Bioeconomy
- Human-centred living environments
  - LivingPlus

World class potential:
- Global business dynamics
- Process and systems competence
- Architecture
- Art

World class:
- Computation and modeling
- ICT
- Materials
- Design
- New media

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Core strategies and KPIs

Research **excellence**

Key Performance Indicators:

- Publication quality (Crown Indicator)
- # of ERC grants
- Competitive research funding
- Awards & recognition
- Quality and quantity of interdisciplinary projects
- Tenured professors (e.g. h-index; Hirsch index)


The current research strength in Computation and Modeling, Materials, Design, ICT and Media.

Interdisciplinary themes selected for future development of interdisciplinary programmes include Digitalisation, Services, Energy and Sustainable Use of Natural Resources and Human-Centric Living Environments.
**Pioneering education**

**Students as co-creators**
- Increasingly project based courses with real-life cases from the industry
- Students as co-creators leads to new openings, increased motivation and self-confidence

**Crossing borders**
- Risk-taking and diversity as resource
- Multidisciplinary Master programs (IDBM, CCIS), Aalto mobility courses between disciplines, Factories, AALTOnaut minor
- International links and collaboration

**Alignment of studies and gaining work experience**
- Comprehensive set of transferable skills for working life
- Integrating summer internships and external projects to the studies
- Systematic coordination of thesis projects
- **Easy access to industrial leaders, entrepreneurs**

**Entrepreneurship**
- Startup Sauna, Aalto Ventures Program, Aalto Centre for Entrepreneurship in collaboration with Stanford University
  - Entrepreneurial culture, mindset and skills
  - Business acceleration
  - Ecosystem creation
Core strategies and KPIs

**Pioneering education**

Aalto University is an international and multicultural learning community.

**KPIs:**

- Teaching quality
- Student performance
- Alumni & employer satisfaction
- Multidisciplinary graduates

Over 15,000 applicants, only one in ten accepted
2. ICT at Aalto

1. University view
2. Five core ICT departments
3. The ICT M.Sc. programme reform
2.1 ICT at Aalto – the university view

**Themes driving interdisciplinary research**
- Digital society
- Process and systems competence
- Architecture
- Art

**World class potential**
- Global business dynamics
- Energy & sustainable use of natural resources
- Human-centred living environments

**World class ICT**
- Computation and modeling
- ICT
- Materials
- Design
- New media

Based on extensive international research evaluation (RAE), 2009.
National leader in digitalisation research

• Some 80 professors in ICT and another 80 in core applications
• Competitive research funding of 50+ M€ per year
• Annually 400+ M.Sc. degrees and some 100 PhD’s
• Students make some 100,000 ECTS/a in digi-relevant courses
• Several National Centres of Excellence and other strategic competitive funding in the area
• ERC and other competitive personal grants
• Close collaboration with University of Helsinki
  • HIIT – Helsinki Institute for Information Technology
  • HICT - Helsinki Doctoral Education Network in ICT
• European level networks: EIT ICT Labs
Challenges

• ICT activities are, for historical reasons, quite fragmented across (almost?) all of the six Schools, even within a single School
• Difficult to make strategic decisions and achieve critical mass
• Solutions?
• School restructuring? → Challenging
• Chosen approach: cross-school platforms
  • Aalto Digi-platform, Aalto Energy platform
Aalto Ecosystem for crossing borders

Covers research, education and societal interaction & impact

Joint vision creation

Multidisciplinary Platforms

Hubs

Joint spaces to meet and act

Joint activities

Programs

Aalto University
2.2 Five core ICT departments (1/5)

Department of Information and Computer Science (ICS, School of Science)

Head: Pekka Orponen

Personnel: 13 professors, ~120 FTE personnel, ~ 8.4 M€ total budget

Profile: Methods: algorithms, machine learning etc., with advanced applications

Focus areas
1. Algorithms, logic and complexity
2. Machine learning and computational inference
3. Big data: data analysis, distributed computing
4. Smart society and sciences
Five core ICT departments (2/5)

Department of Computer Science and Engineering (CSE, School of Science)

Head Prof. Heikki Saikkonen

Personnel 12 professors, ~130 FTE personnel, ~9.5 M€ total budget

Profile Software, systems, services

Focus areas
1. Distributed pervasive data-intensive systems
2. Applications:
   a) Industrial Internet
   b) Pervasive mobile applications
3. Empirical software engineering
4. Systems security
5. Learning technologies
Five core ICT departments (3/5)

Department of Media Technology (MT, School of Science)

Head  Prof. Lauri Savioja

Personnel  7 professors, ~57 FTE personnel, ~4 M€ total budget

Profile  Efficient computational methods for media

Research directions
1. Computer science of human movement
2. Material capture and realistic rendering
3. Optimal acoustic conditions
4. Web 4.0
Five core ICT departments (4/5)

Department of Communications and Networking (COMNET, School of Electrical Engineering)

Head Prof. Riku Jäntti

Personnel 9 professors, ~110 FTE personnel, ~7.7 M€ total budget

Research areas
1. Advanced radio systems
2. Evolving Internet
3. Information theory
4. Network architectures, protocols, and services
5. Network economics
6. Network security and trust
7. User interfaces
Five core ICT departments (5/5)

Department of Signal Processing and Acoustics (SPA, School of Electrical Engineering)

Head Prof. Jorma Skyttä

Personnel 10 professors, ~100 FTE personnel, ~7.5 M€ total budget

Research areas
1. Audio signal processing
2. Communications acoustics: spatial sound and psychoacoustics
3. Metrology
4. Speech communication technology
5. Speech recognition
6. Speech technology
2.3 The ICT M.Sc. programme reform

• As of Autumn 2015, the five core ICT departments will join together to offer a common cross-school (SCI + ELEC) M.Sc. degree programme on Computer, Communication and Information Sciences (CCIS)

• The programme will merge together all the former 10+ M.Sc. programmes in which the departments were previously participating

• The programme is expected to host ~350 students and graduate ~150 M.Sc. degrees per year

• Two broad majors
  – Computer Science
  – Communications Engineering

• Six specialised majors
The CCIS M.Sc. programme

• Joint Master’s Degree Program organised by Aalto Schools of Science (SCI) and Electrical Engineering (ELEC)
• Eight majors and altogether 16 tracks
• Faculty includes over 40 professors
• All teaching in English
• Majors:
  • Computer Science (broad, six tracks)
  • Communications Engineering (broad, four tracks)
  • Software and Service Engineering
  • Mobile Computing, Services, and Security
  • Acoustics and Audio Technology
  • Machine Learning and Data Mining
  • Speech and Language Technology
  • Game Design and Production
Example: The Computer Science major

Organised jointly by four departments:
- Computer Science and Engineering
- Information and Computer Science
- Media Technology
- Communications and Networking

Six different tracks (broad major)
Faculty includes 24 professors
Structure of Computer Science major

Core Courses (choose at least 2)
- Computer Graphics
- Discrete Models and Search
- Information Security
- Machine Learning: Basic Principles
- Operating Systems
- Principles of Algorithmic Techniques
- Web Software Development
- User Interfaces

Tracks (can specify further core courses)
- Algorithms, Logic, and Complexity
- Big Data and Large-Scale Computing
- Interactive Technologies
- Secure Systems
- Software Systems and Technologies
- WWW Technologies, Applications, and Science
3. Innovation and Entrepreneurship

1. Corporate collaboration
2. Student-driven entrepreneurship
3. EIT ICT Labs
The Otaniemi peninsula & bay area: a hub for technology, business and arts

5 billion euros to be invested in the area
3.1 Corporate collaboration

The university has built a number of long-term strategic partnerships with significant Finnish and international enterprises.
The university has an extensive network of partnerships in corporate collaboration and research-based entrepreneurship.
3.2 Student-driven entrepreneurship
Aalto ecosystem
– a European startup hotspot
Venture Garage

- The actual place where Android Aalto, Startup Sauna, etc., are happening
- On Otaniemi hitech hub campus
- Coaches include the founders of Angry Birds and MySQL
- Very exciting place and concept
- In the middle of a campus of 32,000 hitech professionals and scholars from 110 countries
Startup Sauna

• New breed of startup development (formerly known as “incubation” in some places)
• Based on the question: **Do you have a scalable, product-based global success story or not?**
• If yes, then you’re developed. Hard!
• Not only Finland, but the whole Baltic Rim
• Initiated and operated by a student-run “Aalto Entrepreneurship Society” (AaltoES)
• Supported by Aalto University
• Of course in Otaniemi, just like Android Aalto, etc.
3.3 EIT ICT Labs

EIT ICT Labs’ mission is to drive European leadership in ICT-related innovation to foster economic growth and enhance the quality of life of European citizens.
A Pan-European Innovation Ecosystem
Affiliate Partners
Action Lines

Deploy ICT in the European environment and industry (innovation *with* ICT)
- Quality of life in our cities
- Intelligent environments
- A healthy life
- Sustainable energy supply
- Made in Europe and secured critical infrastructures

Create a safe and competitive European ICT infrastructure (innovation *in* ICT)
- Future Communication
- Service and Data Infrastructures
- Safe Cyberspace

- CYBER-PHYSICAL SYSTEMS
- HEALTH & WELL-BEING
- SMART ENERGY SYSTEMS
- SMART SPACES
- URBAN LIFE & MOBILITY

- FUTURE CLOUD
- FUTURE NETWORKING SOLUTIONS
- PRIVACY, SECURITY & TRUST

Aalto University
EIT @ Otaniemi Open Innovation House
4. Key events and decisions

1. Window of opportunity
2. Three radical changes
3. Tenure-track system and internationalisation
Universities can change
Reforms in action 2010-2013

Research excellence
• International research papers +28%
• Competitive research funding +31% (EU R&D-funding +82%)

Attracting talent
• International faculty +62% (over 30% of new tenure track professors)

Pioneering education – students as our partners in learning
• PhD degrees +24%
• Interdisciplinary education (e.g. Design Factory, AaltoNaut), transferrable skills

Entrepreneurship – students driving change
• Aalto Ventures program with Stanford University, partnering with Tongji
• AaltoES, Start-up Sauna, SLUSH
• Recent report by MIT identifies Aalto University as one of the 5 ”Rising Stars” among 200 university-based innovation ecosystems

Professor
N. Asokan
Secure Systems

Associate Professor
Aristides Gionis
Machine Learning and Data Mining
New operational concepts and higher level of ambition called for from Finnish universities

State and private money available!

But not for conventional models

Learning outcomes needed to match global job market & global and national challenges

Interdisciplinarity is commonplace in industry – why not in Academia?

The three universities acknowledged a need for renewal, as well as a need to decentralise its administration and focus more on research (science and art) and teaching.

The government wanted to reduce the number of universities and pool its resources. (In 2009 there were 20 universities. The evident long-term goal is less than 10.)
Opportune timing

The new Universities Act was under preparation. Novel ideas were called for. The idea of an "innovation university" was launched. The concept of foundation universities was accepted.

In 2007 and 2008, industry made a commitment to finance the ambitious exercise.* In 2009, the economy entered a recession!

The new Finnish government approved the idea in the Spring of 2008.

(* The target of collecting 200 million euros in private money and 500 million euros in public money for the foundation endowment was historic from the standpoint of previous Finnish targets!)
4.2 Three radical changes

Merger of three universities (and 3+ cultures!)
• This was the most visible change, but perhaps not even the most profound one.

Radical change in governance model
• The management of the university as a private foundation, detached from the state bureaucracy and governed by a strategic board of trustees has been crucial for pursuing rapid and far-reaching changes. There are also risks in moving away from the traditional university model of collegial decision-making.

Radical change in mission and ambition level
• From educators of professional labour for the Finnish economy to an aspiring world-class university. The change is a challenge, but is happening, with strong support from the industry and Aalto board.
Key elements in implementation

Focusing
• Good resources on a Finnish scale, marginal resources on a global scale. (The budget of MIT > the sum of the Finnish universities budgets! It is realistic to compete with "MITs’” only within a very limited scope.) **Intensity** of activities **must be high**.

Tenure-track career system
• Huge success! Innovative and productive junior professors in focus.

Pioneering
• Traditional paths to the top are crowded. Aalto tries to find new ways via societal impact & innovation. The productive energy unleashed in student entrepreneurship and co-creation has been incredible! (E.g. [http://aaltoes.fi/](http://aaltoes.fi/), [http://aaltodesignfactory.fi/](http://aaltodesignfactory.fi/))
4.3 The Aalto tenure-track system

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<thead>
<tr>
<th></th>
<th>Fixed term</th>
<th>Assistant Professor (1)</th>
<th>Assistant Professor (2)</th>
<th>Associate professor</th>
<th>Professor</th>
<th>Distinguished Professor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Research *</td>
<td>65%</td>
<td>60%</td>
<td>50%</td>
<td>40%</td>
<td>Negotiable</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+/-10%</td>
<td>+/-10%</td>
<td>+/-10%</td>
<td>+/-15%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teaching</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td>30%</td>
<td></td>
</tr>
<tr>
<td></td>
<td>+/-10%</td>
<td>+/-10%</td>
<td>+/-10%</td>
<td>+/-15%</td>
<td>+/-15%</td>
<td></td>
</tr>
<tr>
<td>Activity in Scientific Community and Academic Leadership</td>
<td>5%</td>
<td>10%</td>
<td>20%</td>
<td>30%</td>
<td>Negotiable</td>
<td></td>
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<tr>
<td></td>
<td>+/-5%</td>
<td>+/-5%</td>
<td>+/-10%</td>
<td>+/-15%</td>
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* /artistic and professional work
The tenure-track system and internationalisation

- The tenure-track system was introduced full-scale at the beginning of Aalto 2010, and has been a huge success in raising the quality and internationalisation of faculty.
- By Aug 2014, 193(!) new faculty had been recruited to the tenure track. This is > 50% of all Aalto professors!
- Of the applicants, 70% have been international, and of the appointed professors 30%.
- At least in CS, typically the most attractive candidates have been at the Assistant Professor (2) and Associate Professor levels.
HC of international personnel

Aalto Total
Academic Personnel
Other Personnel

2010 2011 2012 2013

619 706 910 938
474 529 707 772
49 58 57 53

Aalto University
5. Future prospects

1. Campus development
2. School/department structure renewal
5.1 Campus development

**Metro**
- A new subway line will connect Otaniemi to downtown Helsinki and the eastern Helsinki residential areas in 2016. Connection time to downtown 10 minutes.

**Campus renewal**
- The university is investing at least 300 M€ in new construction on campus in the next few years. All Aalto activities will be gathered to Otaniemi and a new central building will be constructed, with premises for the ARTS School, student services, and direct connection to the Metro. The core campus will become a pedestrian zone.
a Re-imagined campus in Otaniemi

Campus vision 2020
5.2 School/department structure renewal

• The present School structure for Aalto is the result of a certain historic development, and is certainly not optimal. There have been initiatives for e.g. a distinct School of ICT and a School of Life Science Technologies.

• However, revising the school structure is a major operation because it changes the organisation which supports the present Aalto reforms, so requires careful thought.

• A merger of the three computing-related departments at the present School of Science to a single Department of Computer Science is proposed to happen in the beginning of 2015.
  - The new CS department would have ~35 professors, a staff of ~400 persons, and an annual budget of ~25 M€.
Thank you for your attention!

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