Where science and art meet technology and business
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The unique competitive advantage of Aalto University is based on cooperation. Aalto is where top experts of different scientific disciplines can meet and succeed. Our people have made Aalto known for quality science, art and teaching.

World-class companies, scientific breakthroughs and achievements of an individual level have three things in common: strong faith in one’s competence and your ability to tackle almost impossible-sounding objectives; strong will to succeed and proceed towards the chosen direction even in difficult times; and a unique capacity to create new and better things. Aalto University has all these prerequisites.

A better world, a stronger Finland
Aalto University has two missions: a better world and a stronger Finland.

The university changes the world through top international research, multidisciplinary cooperation, pioneering education, the bold breaking of boundaries, and renewal.
A shared campus established in Otaniemi

Sophia Tigerstedt's entry won a student competition to design a campus garden.

The current campuses of Aalto University are located in the Arabia and Töölö areas in Helsinki and at Otaniemi in Espoo. The university also has operations in Mikkeli, Lahti, Vaasa and Pori in Finland.

Aalto University’s shared campus will be gradually established in Otaniemi from 2013 onwards.

For example, all bachelor-level education will be centralised in Otaniemi in stages, starting in 2013.

The primary objective is to make the campus into a vibrant and interactive research and study environment where work, study, hobbies and everyday life are naturally interconnected.

The mission of building a better world has historically been the common denominator of scientific and artistic institutions. As a university that combines both dimensions, Aalto has both an enhanced responsibility and exceptional opportunities to carry out this mission.

In addition to this, Aalto University also has an important national mission: to reinforce the international position of Finland, its competitiveness, and the well-being of the Finnish people. These objectives can be reached through research and by educating responsible and open-minded experts as society’s visionaries and actors who promote change.

Management and organisation

- Aalto University derives its funding from a foundation.
- The foundation capital and its proceeds provide the university with a good financial standing and enable it to implement its strategy.
- Aalto University comprises the School of Arts, Design and Architecture, the School of Business, the School of Chemical Technology, the School of Electrical Engineering, the School of Engineering, and the School of Science.
- Each school is headed by a dean, and every school has an academic committee.

- The executive bodies of Aalto University are the board, the president and the university academic affairs committee. The university has three vice presidents.
- The first president of Aalto University, Professor, Tuula Teeri (Ph.D.) has previously acted as the Vice President of the Royal Institute of Technology (KTH) in Stockholm, Sweden.

Operations are guided by values

The values of Aalto University are passion, freedom, courage, sense of responsibility and integrity.

Passion means that work is done with ambition and commitment. It is faith in oneself, each other and mutual possibilities.

We emphasise the freedom to think independently and to take the initiative. Freedom is the cornerstone of academic thinking. Freedom means the permission, or even responsibility, to ask and question things – but also the willingness to respond and take a stand.

Courage means that at Aalto, we do not like to think of anything as categorically impossible, even though not everything is possible. Trial and error and their repetition even in the face of failing have led to many scientific breakthroughs.

In accordance with its mission, Aalto University has a responsibility not only for its own success and that of the community, but also for the future of Finland and of the world. We consider this responsibility both an honour and a privilege.

All our activities are guided by integrity – honesty, equality, impartiality and respect for others.

Key figures of Aalto University

- Staff: 5 000 of whom 350 are professors
- Students: 20 000 of whom 3 500 are doctoral students
- International students: 2 600
- Every year, Aalto University awards 1 400 bachelor’s degrees; 1 200 master’s degrees and 170 doctoral degrees
- Alumni: 75 000 of whom 25 000 are registered
- Annual budget: €400 000 000 (2011)
Distinguished Professor Risto Nieminen is the director of the Centre of Excellence in Computational Nanoscience. The unit, which operates at the Department of Applied Physics, is among the best in the world in its sector.

“The Academy of Finland provided us with funding and appointed us a Centre of Excellence in Research, which has enabled us to expand our operations and add new fields of activity and research groups. In 2012, we will be strengthened by more expertise in chemistry and quantum phenomena.”

According to Nieminen, the centre does not “make theory and calculations merely from the joy of calculation.” Instead, the unit also acts in close collaboration with experimental research groups. In addition, the unit has extensive cooperation with various businesses.

One of the most interesting materials in practical applications is graphene, where Nieminen’s research group cooperates with Nokia Corporation and the University of Cambridge.

“Different kinds of carbon deposits have been studied for a long time. It came as a surprise that a graphene membrane with the thickness of one atomic layer is extremely stable in mechanical terms, and it can be separated from its foundation — this was done almost by accident in 2004. After that, graphene became a hot research subject.”

Graphene is used in, for example, touch screens of electronic devices as well as in various kinds of microelectronics components and sensors. Molecules which sense their environment can also be attached to a graphene membrane. For example, an artificial nose could be integrated into a mobile phone to provide it with a breathalyser function.

In addition to nanotechnology, Nieminen is also interested in the more philosophical nature of materials manipulation. Customisation of atoms in a differing sequence and as different structures is like playing with Legos.

“We organise atoms in the world in different ways. We consider the smartest and most optimal way to use this limited number of atoms.”

The influence of nanosciences is visible everywhere around us. There are applications from medicine to consumer electronics. The energy industry is one of the key sectors. There is interest in, e.g., new solar cell materials and more efficient utilisation of waste energy.

Risto Nieminen was appointed the first Distinguished Professor in 2010.

“I regard it as a distinction to the work done by our entire unit. Of course it gladdens one’s heart; for a scientist, positive assessments by peers are always extremely motivating.”

Excerpts from research:
Centre of Excellence in Computational Nanoscience

Organiser of atoms

Professor Risto Nieminen
Department of Applied Physics:
Director of the Centre of Excellence in Computational Nanoscience (COMP)
School of Science
Nieminen was appointed Distinguished Professor in 2010.

“We organise atoms in the world in different ways. We consider the most optimal way to use this limited number of atoms.”
Aalto University’s solid expertise in the fields of economics, art and design and technology create a foundation for the most diverse scientific breakthroughs.

Scientific special know-how of the highest quality is a prerequisite for excellent multidisciplinary and interdisciplinary research. Only thus can a multidisciplinary approach bring clear added value to the university. This means that the various departments are at par with the corresponding departments at other international top universities. This can be achieved when Aalto University builds on its own strengths and develops profound competence in carefully selected areas.

Four areas of strength in research
On the basis of a research assessment exercise conducted at Aalto University in 2009, the areas of strength in research include computation and modelling, materials research, design, and ICT and media.

Top-level expertise in computational science and modelling at Aalto University is found, in particular, at the Department of Information and Computer Science, Department of Applied Physics, Department of Biomedical Engineering and Computational Science, the Helsinki Institute of Information Technology (HIIT), and the O.V. Lounasmaa Laboratory.

The units’ research groups develop new computational methods and apply them to the needs of industry
Academy of Finland’s Centres of Excellence in Research at Aalto University

The Centres of Excellence in Research, funded by the Academy of Finland, are among the best representatives of their respective branches of science. Each research group has the opportunity to do research at a high international level with funding provided for five years.

Aalto University’s Centres of Excellence in Research for the period 2012–2017:
- The Centre of Excellence in Computational Nanoscience – COMP, the School of Science
- The Centre of Excellence in Low Temperature Quantum Phenomena and Devices, the School of Science
- The Centre of Excellence in Computational Inference Research – COIN, the School of Science

and in 2008–2013:
- The Centre of Excellence in Generic Intelligent Machines Research, the School of Electrical Engineering
- The Centre of Excellence in Smart Radios and Wireless Research, the School of Electrical Engineering

in addition, Aalto University takes part in:
- The Centre of Excellence in Algorithmic Data Analysis Research (University of Helsinki, Aalto/School of Science)
- The Centre of Excellence in Molecular Systems Immunology and Physiology Research (VTT, University of Helsinki, University of Turku, Aalto/School of Science)

and other branches of science. The fields of research extend from theoretical modelling and nanosciences to different practical applications, such as mechanisms of genetic regulation and data communications systems.

Materials research is performed at all the schools of technology of the university. The Otaniemi campus houses, among others, the National Atomic Resolution Microscopy Center and high-tech cleanroom facilities.

Biomaterials, materials needed in nuclear energy technology, and nanomaterials are a few examples of the research done in this sector. A multidisciplinary perspective is commonplace in materials research: scien-

Terahertz technology: applications from the skin to space

School of Electrical Engineering
Centre of Excellence in Smart Radios and Wireless Research (SMARAD)

Research topics at the Centre of Excellence in Smart Radios and Wireless Research (SMARAD) include multiple-antenna systems and terahertz technology.

Terahertz technology has plenty of practical applications. In the future, passive terahertz imaging that utilises humans’ own radiation may replace the low-intensity X-ray scanners used in security checks at airports. Terahertz imaging can also be used to examine diseases of the skin. Among other things, it enables cellular changes and the development of skin cancer to be detected sooner than with optical methods.

Terahertz technology was created in atmospheric and space research. Today, it can be used to monitor the development of quantities of the various elements in the atmosphere – such as greenhouse gases – from satellites.

A key research topic in multiple-antenna systems is improvement of the connection between mobile phones and base stations. When several antennas can be used for the same channel in both the phone and the base station, audibility can be ensured in almost all circumstances. At the same time, this new technology saves a considerable amount of energy consumed by base stations.

Indeed, the work done by SMARAD is keenly connected with the success of Finnish telecommunications enterprises; this genuine social demand has also been a key strength of the unit. Another strength has been cooperation between different research groups. The consolidation of competence in traditional radio technology, signal processing and circuit design has created a whole that is bigger than its parts.
The production of energy always generates more waste heat than energy that can actually be utilised. The research team in inorganic chemistry, led by Academy Professor Maarit Karppinen, develops new environmentally friendly, thermoelectric oxide materials that help convert such waste heat into electricity.

Thermoelectricity is a phenomenon where an element placed between a cold and a warm space produces electricity. The greater the temperature difference, the more electricity can be produced.

“Finland has a large difference between indoor and outdoor temperatures in winter, so thermo elements installed in the walls of buildings, for example, are an interesting application”.

Industrial processes generate a great deal of waste heat. Electricity can also be produced from the waste heat generated by exhaust gases of automobiles. Scientists elsewhere have already developed watches that draw power from the difference in temperature between the air and the human body.

Besides electricity production, thermoelectric materials can also be used for cooling – mobile refrigerators are one such example.

Karppinen focuses her research particularly on thermoelectric oxide materials. Oxides are much more ecological than the alloys with tellurium used in most applications today.

“Oxides are also more affordable than tellurides and withstand higher temperatures.”

Karppinen became interested in thermoelectric materials while working at the Tokyo University of Technology. Karppinen’s research group has an ongoing researcher exchange programme with Japan, which pioneers the research in thermoelectric materials.

“For a chemist, oxide materials are extremely interesting. They have an extremely wide range of properties and their applications are closely linked with energy savings and a cleaner environment”.

The same chemist’s tools can be used to customise oxide materials for different applications. Waste heat can be used to produce electricity in an ecological manner, it can be stored in lithium-ion batteries and transported through superconductors without any loss. The research carried out by Karppinen serves all these applications.

“We develop new next-generation materials. The time span from basic research in materials to the first commercial applications is at least 10 years.”

Excerpts from research:
Research in thermoelectric materials

Academy Professor Maarit Karppinen
Director of the Department of Chemistry and head of the research group in inorganic chemistry
School of Chemical Technology
Materials science improves the safety of nuclear power plants

School of Engineering
Department of Engineering Design and Production
Research group in materials science and engineering

The group of materials science and engineering at the Department of Engineering Design and Production has a long tradition of diversified materials research on nuclear power plants. Solutions related to materials science and engineering contribute to improvements in the safety, economic efficiency, usability and maintenance of nuclear power plants.

The research focuses on enhancing current power plant solutions, so-called third-generation reactors as the one at Olkiluoto 3, and fourth-generation reactors that are based on completely new technological solutions.

Technical advances mean that the materials and structures at nuclear power plants can be improved further. Research topics in this field include, e.g., materials of the reactor pressure vessels and its fittings, pipes, pumps and valves; welding technology; non-destructive inspections and structural solutions.

For example, when reactor pressure vessels are made of large ring-type forgings, and induction bending and complex forged pieces are used in the pipeline, the number of welding joints necessary can be decreased significantly.

In welding, there has been a shift to so-called narrow gap techniques where the number of potential welding errors and the volume of items to be inspected are reduced. Most corrosion and fracture problems can be eliminated, thanks to advanced materials. The service life of old plants has been raised to 60 years and even beyond. At the same time, research in the aging mechanisms of materials has become extremely important.

The establishment of EIT ICT Labs in Finland has been important for accelerating innovations in the information and communication technologies. EIT ICT Labs is a knowledge and innovation community of the European Institute of Innovation and Technology (EIT) with the mission to make Europe a global leader in ICT innovation for socio-economic benefits. EIT ICT Labs

Academy Professors lead research forward

The Academy of Finland chooses as an Academy Professor a person who has proven to be an eminent researcher and is deemed to contribute to the advancement of research in their branch of science.

- The researcher is seen to have the capability to make significant scientific breakthroughs
- The appointment gives the Academy Professor the opportunity to focus on research
- Academy Professors are employed by the organisation where their professorship is.

At the moment, Aalto University has seven Academy Professors:

- Riitta Hari, systems neuroscience
- Olli Ikkala, biological and soft matter physics
- Risto Ilmoniemi, biomedical engineering
- Maarit Karppinen, thermoelectric materials
- Visa Koivunen, signal processing
- Riitta Salmelin, systems and cognitive neuroscience
- Jukka Seppälä, bioactive and biodegradable polymers

ICT and media attract a lot of interest with ubiquitous digitalisation. The research conducted at the School of Science and the School of Electrical Engineering is focused on theoretical computer science, information science, software systems, software engineering, data communications software, communications and networking, information theory, and signal processing.

Together, the four schools of technology constitute a powerful cluster of ICT expertise that has plenty of collaboration opportunities with other universities.

The consolidation of theoretical ICT research, data communication technology, user-centred design, digital contents creation and competence in business creates cornerstones for innovations relating to the digitalisation of services and their usability.

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The Aalto University design research focuses particularly on user-centred design, cultural design and sustainable development.

User-centred design looks at, for example, participation in design and the consumption of designed products. Approaches and perspectives in research include usability studies, interactive design, user experience, accessibility, proactive design, joint design and service design. Research is focused on, for example, the development of methods in user-centred design and studying adoption of new technology.

Cultural design is a general term used for different humanistic approaches to design research. They include, among others, the history of design, research in design values and professionalism, research in intercultural connections, research in social design, as well as research in the interface between artistic working methods and design.

A new area of competence in design research is research in sustainable development. This research area includes the sustainable use of materials, sustainable consumption behaviour, and planning and support of product-service systems that furthers sustainable development.

connects excellent European partners of the Knowledge Triangle in education, research and industry.

Design focuses on research in user-centred design, the cultural connections of design and design that is in accordance with sustainable development. In addition to products, design is also needed in, for instance, the design of information systems and software, design of services, and urban planning.

A multidisciplinary research environment offers new possibilities for interaction between design research and other branches of research. Combining user-centred design with technical expertise allows the creation of a new approach to sustainable development and other issues.

Tackling humanity’s greatest challenges
The expertise of Aalto University in its strong research areas as well as its multidisciplinary approach are perfectly exemplified by its research projects on energy. Sustainable use of natural resources is one of the greatest challenges of the human race. Aalto University has plenty of competence in that field, from individual solutions such as solar cell materials all the way to larger entities such as energy-efficient urban planning.

Solving great challenges requires consolidation of various sectors of competence. Multidisciplinarity is visible in, for example, the fact that considering business

The European Research Council provides grants for the most promising research
The European Research Council (ERC) supports groundbreaking research in all branches of science by funding the work of top researchers.

- ERC research grants have been awarded since 2007, and by 2011, approximately 40 Finnish researches have received the grant
- In 2011, Aalto University had nine recipients of the ERC research grant
- Seven of them are ERC Starting Grants, which are five-year grants awarded to talented new researchers for the establishment of their own research group
- The other two are ERC Advanced Grants for distinguished top researchers:
  - Academian of Science, Academy Professor, neuroscientist Riitta Hari, the School of Science, the O.V. Lounasmaa Laboratory
  - Academy Professor Olli Ikkala, the School of Science, the Department of Applied Physics
models is an integral part of the development of technical solutions. Finding an excellent method of reducing the carbon footprint is not enough if no one uses it. That is why a profound understanding of consumer behaviour is very important in the research and planning of solutions for sustainable development.

Aalto University supports multidisciplinary research by providing opportunities for independent cooperation between experts in various fields. Through themes that require a cross-disciplinary approach, new research environments can evolve into more comprehensive research programmes or units.

Internationally recognised research
Bringing together artistic expression and competence in the fields of technology, design and business provides opportunities for entirely new kinds of solutions and applications. Inspiration for such regeneration may originate in any sector. Research is also conducted in interaction with the surrounding society: at best, innovations and new applications can generate new areas of growth, employment and well-being for Finland.

The best research in each field emerges only through the actions of visionary and intuitive people. Research at Aalto University has received significant amounts of both funding and merits during the first years of operation.

The Academy of Finland, for example, has granted infrastructure funding for projects that support important strategic areas of research at Aalto University, enhance the university’s traditional high quality of expertise, or promote Aalto University’s national and international collaboration with other top universities and research institutions.

Aalto University is also well represented in the Centre of Excellence in Research programme of the Academy of Finland. For example, in 2011 the Centre of Excellence in Computational Nanoscience received its third successive, and the Finnish Centre of Excellence in Computational Inference Research its fourth successive period as a Centre of Excellence in Research. The Centre of Excellence in Low Temperature Quantum Phenomena and Devices, on the other hand, has predecessors in Aalto University’s O.V. Lounasmaa Laboratory (former Low Temperature Laboratory) since 1994.

When Aalto University began operation, the guidelines and foundation for the university’s tenure track system were created at the same time. The tenure track system of the professors provides essential support to Aalto’s objective to become one of the top universities in the world.

The tenure track offers a clear career path
Aalto University’s tenure track system offers researchers a clear and well-supported career path towards professorial tasks. The purpose of the system is to promote the attainment of status as a top-level university.

The stages of the tenure track system are:
1A. Assistant Professor
The first period (3–5 years), fixed-term employment relationship

1B. Assistant Professor
The second period (4 years), fixed-term employment relationship

2. Associate Professor, permanent or fixed-term employment relationship

3. Full Professor, permanent employment relationship

Also, a possibility for particularly distinguished professors:
Distinguished Professor, permanent employment relationship

Depending on the experience and qualifications of the applicant may be recruited at any of the three levels of the tenure track.
Talent scout of experts

Professor of Microeconomics Marko Terviö studies the significance of talent in the job market. In economics research, talent refers to suitability for a certain position or sector that manifests itself as differences in productivity. Often, this type of talent manifests itself only gradually or little by little over the course of one’s professional career.

“Many fields have a great deal of talent but few opportunities to reveal such talent. In such cases, employers compete for the same few people they all know as experts, even though there are many equally talented but less known people available on the market.”

This phenomenon is a contributing factor to the increased earnings of business executives, for example. Everybody wants someone who has held a similar position before and excelled in it.

“The key is getting a chance to demonstrate one’s abilities. Any executive who manages to get into this circle and succeeds even moderately well becomes a scarce commodity and may see a rapid increase in earnings.”

One of Terviö’s research topics is the question of whether there is more skill or luck behind the large incomes. Often, work opportunities present themselves very randomly, whereas the skills paid for are acquired while working.

More extensive experimentation of talented individuals would be more efficient in overall economic terms. However, the market is not perfect: it is not worthwhile for an enterprise to hire a person who, while being talented, is still an unknown because someone else may recruit that person as soon as his or her capabilities have been revealed. This problem is a little less acute in professional sports than in other fields.

“In football, smaller teams have an incentive, created by transfer fees, to give playing time to young promising players. If a player proves to be good and is snatched by a major club, the smaller team will still receive a reward for taking the risk. If there were no transfer fees, the average age of players would probably be higher and young stars would emerge less frequently.”

A wider research question for Terviö is the influence of institutions and technological development on the distribution of talent resources in the economy to different sectors. This can be studied, for example, by comparing capability measurements performed before voluntary education with the subsequent duties and income level of the individuals.

“We have noticed a clear structural change. Previously, capable young people ended up in teaching duties, for example, whereas now they are increasingly found in professions in the financial industry and consultancy business.”

“Many fields have a great deal of talent but few opportunities to reveal it. Employers compete for the same few people they all know as experts.”
Teaching that transcends boundaries

Aalto University believes that education must offer more possibilities than ready-made solutions. Students can affect the content of their studies according to their subjects of interest, career goals and strengths by combining studies in different fields. That is why students are encouraged to seek different forms of cooperation.

The content of teaching at Aalto is developed and implemented hand in hand with research. Aalto reaches towards a culture that encourages continuous learning and creativity and where teaching is pioneering and challenges traditional boundaries. Aalto University is interested in both how studies mould students and in how students can shape their own branch of education and science.

Student-centred activities have contributed to a reform of teaching. For example, Aalto Social Impact has given the idea for the popular and multidisciplinary How to Change the World course. Aalto on Tracks took Aalto students to the World Expo in Shanghai in their own train. Aalto on Waves project, on the other hand, involved a trip to Brazil by ship. On both trips, students completed courses and took part in different learning projects. In situations like these, the university aims to
Aalto Party is where people get together. At the official party of the opening ceremony for the academic year, students and staff members party together.
be as flexible as possible, so good ideas generated by the students can be implemented.

Teaching methods are also reformed through the digitalisation of teaching. For example, Aalto has its own archipelago in Second Life with a virtual chemistry laboratory, where students perform experiments. Another example of new kinds of learning environments are Aalto’s Factories where students, researchers and companies meet in connection with common projects.

In the future, the boundaries between formal and non-formal learning will become increasingly blurred. Data networks change the ways people acquire, distribute and construct information. Traditional teaching methods will continue to co-exist with the new ones, but the role of the teacher will be transformed from a distributor of information into something resembling a coach: teachers support the students in learning new things and constructing meanings.

We are also investing a great deal of time and effort in reforming our degree requirements and structures as well as teaching methods. The new curricula support, for instance, mobility, connections with working life and lifelong learning. International mobility is supported

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**Aalto educates experts with wide perspectives**

Students at Aalto University can earn a bachelor’s degree in economics, art or technology. Masters degrees awarded are Master of Science (Architecture), Master of Science (Landscape Architecture), Master of Science (Technology), Master of Science (Economics and Business Administration) or Master of Arts (Art and Design).

The goal is to educate responsible and independent experts with a wide perspective to point the direction in society.

The graduates work in esteemed positions as experts and directors in the fields of science, art, design, technology and business. The degrees provide them with the capacity for a career as independent entrepreneurs and for scientific and artistic doctoral studies.
Professor Tapio Lokki wanted to eliminate matters of taste from research in concert hall acoustics. That is why he looked to professionals of taste for inspiration: Lokki became the first person in the world to apply the sensory evaluation methods used in the food industry to acoustic research.

“When you buy a bottle of wine, the salesperson does not say whether it is good or bad. They tell you whether it is soft, citrusy or perhaps leathery. We set off to compare the acoustics of different concert halls with the help of similar comparable attributes defined by the assessors in our studies.”

New thinking has raised Lokki to the world class of researchers in virtual acoustics.

Lokki’s research group has conducted several case studies where a so-called loudspeaker orchestra has been used to find out which factors affect the way people experience acoustics. The loudspeaker orchestra, which is assembled on the stage of a concert hall to simulate a symphony orchestra, consists of 34 loudspeakers. The speakers play symphonic music – Beethoven, Bruckner, Mahler and Mozart. So far, “concerts” by the loudspeaker orchestra have been recorded in eight different concert halls.

Study subjects who listened to the concert recordings in a laboratory graded the concert halls according to attributes they specified themselves. In different studies, 60–102 attributes were included in the final analysis; that number illustrates the diversity and complexity of the research topic.

The studied halls varied greatly. Among those rated highest, the level and intimacy of sound were key characteristics.

“A concert hall is an amplifier. It must not sound like a church or studio. The sound should be both clear and blended at the same time, e.g., the strings should form a tapestry of sound, so that you cannot distinguish individual instruments.”

Acoustics in concert halls is affected by, e.g., the shape of the hall, wall materials, the structure of the stage, the seats and their placement, and by dozens of other factors. In acoustics research, one must know how an orchestra really works. Lokki has played the clarinet a long time, and many of his old fellow musicians are now professional musicians and conductors.

“It is our knowledge of music and the everyday life of orchestras that distinguishes us from other research groups in the field. In addition to music, we must understand physics, audio technology, psychoacoustics, mathematics, computer science and architecture as well. I believe that the future lies in diverse research groups like this one.”

“A concert hall is an amplifier. It must not sound like a church or studio.”

Professor Tapio Lokki
Department of Media Technology
School of Science
On teaching

Business models for the Design Association of Peru

For several years, the Aalto University School of Business has been researching Base-of-the-Pyramid (BoP) markets and business operations. BoP refers to user-centred innovations that benefit citizens of limited means in emerging markets. These markets, which comprise approximately four million indigent people, are located in Asia, Africa, South America and Eastern Europe.

Innovations that reduce poverty are not only beneficial on a societal level but also a profitable business. The objective of the BoP project is to build a cooperative network to support sustainable business and to produce tools for user-centred innovation. The idea of the project is to find ecologically sustainable solutions to poverty-related problems together with user communities of limited means.

The goal of the project started in Peru is to utilise design as a competitive advantage. Operation of the Design Association of Peru (Consejo de Diseño del Peru) will be developed and expanded through different business and service models. The project will also promote cooperation between the Design Association and the business world.

The project also entails development of practical business operation with CITEMadera, the centre of innovation focusing on high value-added forestry products supported by the Government of Peru. The goal is to improve its collaboration with small businesses in the furniture industry.

The participants from Aalto University include the International Design Business Management (IDBM) programme together with the BoP Services research programme.

Internationalisation in figures

Aalto University wants internationalisation to be part of all of its operations. Particularly important sections include international partnerships, the mobility of students and staff, student recruitment and the development of an international campus.

Figures relating to international mobility:
- Students of Aalto University who have participated in exchange programmes: 875 (in 2010, 50% of new students admitted to the bachelor level)
- Students who have arrived for an exchange at Aalto University: 870 (in 2010)
- Partner universities in student exchange: approximately 400
- English-language degree programmes: approximately 70
- International double-degree programmes: 19, of which 5 are Erasmus Mundus master's programmes
- Erasmus Mundus doctoral programmes: 1
- International degree students: approximately 1 600 (8% of all degree students)
- Nationalities represented by all students at Aalto University: approximately 100
Studies also include projects carried out in groups, where theoretical information is applied into practice.
Two Centres of Excellence in university education

The Finnish Higher Education Evaluation Council has selected 10 Centres of Excellence in university education for the years 2010–2012. Two of them are at Aalto University:

- The Department of Film, Television and Scenography at the School of Arts
- The Department of Computer Science and Engineering at the School of Science

The objectives of the Centres of Excellence are to improve the quality and relevance of education and to encourage long-term development at universities. In the selection for the 2010–2012 period, the quality of operations was assessed with regard to the following matters: the mission of the unit, programme and course design, delivery of education, outputs, and continual development. International interaction, cooperation across disciplinary, institutional and unit boundaries and networking were also regarded as favourable factors.
Students at Aalto University turned service robots designed for the home upside down. They came up with a revolutionary idea where the robot moves in the ceiling instead of the floor. The ceiling has fewer obstacles, so it is easier for the robot to move and receive energy. Challenges included designing sufficiently light structures for the robot and controlling it.

The students will design and implement a prototype of the CEILBOT robot they have invented and test it in two applications in the home and office. The robot can help physically disabled people in their daily chores and assist with maintenance of high office facilities, such as the replacement of bulbs in pendants.

Mobile service robots in the home like the CEILBOT are one section of the development of intelligent machines. Indeed, this student project will be implemented with the direction of the Centre of Excellence in Generic Intelligent Machines at Aalto University. It also includes students from machine design, electronics, information technology and architecture. The CEILBOT project is part of the MIDE research programme, which is related to digitalisation and energy technology.
Good decisions do not originate from reasoning alone. Scientists are interested in emotion-related brain activations during decision-making.

The aivoAALTO (‘brainWAVE’) research project, headed by Academician Riitta Hari, combines the competence of different schools at Aalto University in a unique manner. The project is a study in social interaction and decision-making.

It is based on strong expertise in brain imaging and systems neuroscience, added with advanced signal processing, film research and studies in financial decision-making. The research group uses modern brain research methods such as functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG). fMRI is used to monitor changes in the oxidation level of the brain, and MEG measures weak magnetic fields related to brain function.

By showing films to test subjects, a fairly natural yet controllable stimulus environment can be created in the brain imaging laboratory. Films can be used to study how similarly different people view their worlds.

“It is fascinating to study the brain events people use to create a shared reality. Which areas of the brain function similarly for different people, and where are the biggest differences? Does the contagion of emotions increase the similarities between the brains of those involved in the interaction?”

Research in brain events related to social interaction is important, because the human mind cannot be understood without studying the functioning of the brain in relation to other people and social practices.

Researchers of neuroeconomics, on the other hand, seek for a neuronal foundation for decision-making with the help of brain imaging. Models for decision-making include, for example, choice-making in games. Good decisions do not originate from reasoning alone, so scientists are interested in emotion-related brain activations during decision-making.

Brain research deals with big questions, at the core of being human. This is what makes the work so fascinating.

“The human brain is basically the same it was tens of thousands of years ago, but people and their skills are completely different. Our brains are moulded by our surroundings, culture and tools. Thus, it is important to study the brain in experimental situations that are as naturalistic as possible.”

Excerpts from research:
The aivoAALTO research project
Chasing a shared reality

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Aalto University wants to be in world class in artistic activities, too. Our objective is that, in 2020, the university is an internationally esteemed reformer and pioneer in art, architecture, media and design.

Art, architecture and design are central forces for change that enable viewing the world from surprising angles. New ideas can be used to promote the development of both human-oriented living environments and sustainable ways of life.

In Aalto’s strategy, artistic activities have been raised to a level alongside research, teaching and societal impact. The achievement of objectives set for artistic activities and the general development of operations are monitored with the help of indicators designed for this purpose and peer review. International experts play a significant role in the assessment.

Indicators that describe the development of operations include, e.g., participation in international and domestic exhibitions and performances as well as international and domestic awards and honours.

For example, in 2010, the university participated in almost 200 exhibitions and performances, where uni-
Artistic activities

University staff, students and alumni received 36 awards or honours.

Other indicators that illustrate artistic activities include expert duties, such as evaluation panels, assessment duties and membership in award juries, which are proof of the professional skills of members of the Aalto community and the confidence felt toward them.

Aalto University’s latest school, the School of Arts, Design and Architecture began operation in January 2012. It brings together the areas of designing and implementing human-oriented environments that build on the humanistic and cultural tradition and base their research and teaching on strong artistic orientation.

The school combines design, media, architecture and art, and its basic philosophy is evident in its human-centred and user-oriented approach to research, artistic activities and teaching.

A review of ideas by new graduates

Masters of Aalto (moa.aalto.fi)

MoA is a presentation of Aalto University students that emerged from the tradition of Masters of Arts thesis projects of the School of Art and Design (currently the School of Arts, Design and Architecture).

MoA treats the public to a thought-provoking cavalcade of outstanding master’s thesis works and up-to-date research, unique statements, concepts and products realised through co-operation with businesses, and artistic work. For students earning their master’s degrees, the event offers an opportunity to interact with society, future employers, the media and other movers and shakers.

Over the years, MoA has transformed itself, grown and changed venues. However, the basic idea has remained unchanged: MoA is the collective effort of the graduating generation to present the creative energy of the university.

Cutting-edge photography

Helsinki School (helsinkischool.fi)

Helsinki School is a concept that includes various activities, education and exhibitions to present works by photographic artists – students, graduates and teachers – at the Aalto University School of Arts, Design and Architecture.

Helsinki School does not refer to a geographical area, nationality or to any one style. On the contrary, it represents a new way of thinking born at Aalto University as well as a new approach to the art of photography.

Through its work, Helsinki School has emerged as an international phenomenon. Works by its photographic artists are displayed all over the world. It also has its own gallery in Berlin.
Professor Päivi Törmän heads the research group in quantum dynamics at the Department of Applied Physics. The research is divided into two main areas: quantum dynamics of ultracold gases and nanoplasmonics. The former is computational and theoretical, the latter experimental. In both, understanding phenomena at the nano-scale is a key element.

Both research areas have significant practical applications relating to the resolution of global energy challenges.

“Ultracold gases are a field under active research globally. During the past 15 years, research in the field has resulted in two Nobel prizes in physics”.

Research in ultracold gases can help develop a microscopic theory of high-temperature superconductors, which could transfer electricity without any loss of power. This would make it possible to transmit electricity affordably across long distances and utilise, for example, solar energy collected in deserts.

In nanoplasmonics, the particular research interest of Törmän is the strong coupling between surface plasmons and molecules; in this field her research group is one of the pioneers in the world.

“Nanoplasmonics studies applications in solar energy harvesting, among others. Plasmonics helps to guide more light inside solar cells and also to generate more electric current.”

Applications studied by Törmän include nano-sized sources of light and lasers, which can increase the storage capacity of information to a significant degree.

Scientists have already succeeded in connecting plasmonic structures to solar cells in the laboratory. Practical applications in high-temperature superconductors are further away in the future.

Päivi Törmän became interested in this challenging field at a very early age.

“Quantum physics intrigues me because it is so different from everyday life. Here, you really have to stretch your imagination because some matters are so counter-intuitive. Nanosciences are a new branch of science that has numerous opportunities relating to the grand challenges.”

Päivi Törmän also solves challenges in the Research and Innovation Council appointed by the Government, where she has been a member since 2007. The Council discusses matters related to the direction, follow-up, evaluation and co-ordination of science, technology and innovation policy.

“Quantum physics intrigues me. Here, you have to stretch your imagination because some matters are so counter-intuitive.”
One of the key duties of Aalto University is to understand and anticipate the needs of society. The university wants to be an active source of social influence and contribute to the well-being and quality of life of Finnish citizens.

Such active influence is predicated on extensive networking in a variety of different directions and broad-based cooperation. The university is in close interaction with both various actors in Finnish society and international partners.

Aalto’s societal impact is evident in, for example, several projects that have been carried out together with both businesses and the public sector.

The schools of Aalto University have cooperated actively with different companies for decades. The objective of these joint projects is to promote high-quality research that meets the needs of the business world.

Social interaction is represented by, for example, the Aalto Camp for Societal Innovation (ACSI). The purpose of the ACSI activities is to activate the collaboration of professors, researchers and students with municipalities, public administration, enterprises and Aalto University’s other interest groups in order to produce new innovations. The ACSI has already solved challenges
Societal impact

Aalto University is also cooperating increasingly with various cities in order to resolve the challenges they face with regard to urban development and the quality of life. In Espoo, the university is taking part in a project called T3, which looks for new solutions in collaboration between science, art, and business. In Helsinki, Aalto cooperates in projects that help combine working and living and, on the other hand, improve the city’s traffic systems.

As defined in its strategy, Aalto University educates responsible, independent but team-spirited and broad-minded experts to act as society’s visionaries. Social responsibility is an essential part of teaching at Aalto University. For example, the various schools’ joint Master’s Programme in Creative Sustainability deals with the themes of sustainable development and corporate responsibility. The same issues are also discussed in the students’ own Aalto Social Impact movement.

Supporting and encouraging entrepreneurship is also part of the societal impact of the university. Aalto University wants to combine research and the students’ ideas into commercial products and services. In that field, the university cooperates with Tekes – the Finnish Funding Agency for Technology and Innovation and the Federation of Finnish Technology Industries, among other parties. Aalto Entrepreneurship Society (Aaltoes),

A good leader, a better world

At Aalto University, the provision of leadership development services is the responsibility of Aalto University Executive Education Oy (Aalto EE). The company’s mission is to build a better world through better leadership and to educate a new generation of leaders.

Aalto EE offers high-quality development services in enterprise management by utilising the expertise of Aalto University and its extensive international network. Aalto EE brings a multidisciplinary approach and new, innovative learning methods to the development of management.

The education is highly recognised at an international level; the Aalto EMBA programme, for example, achieved the top spot among Nordic countries in the Executive MBA 2011 comparison conducted by the Financial Times.

Aalto EE’s strengths are a global model of operation and a diverse range of services in Finland, Poland, Singapore, South Korea, Taiwan, China and Indonesia. The company aims to emerge as a bridge builder between East and West in the field of executive education.

The continuing education offered by the university, Aalto PRO, has also been organised to match Aalto’s multidisciplinary model of operation. The Aalto PRO training solutions constitute a unique combination of practical knowledge and the most recent research information from Aalto University.

Aalto EE’s Profile magazine has received awards in Finnish and international magazine competitions.
Home base for growth entrepreneurs

Aalto Center for Entrepreneurship (ACE) (ace.aalto.fi, aaltovg.com, aaltoes.com)

Aalto University’s entrepreneurship and innovation services are the responsibility of ACE (Aalto Center for Entrepreneurship). ACE coordinates activities related to the transfer of technology, intellectual property rights, start-up companies as well as teaching and research on growth entrepreneurship. Its objective is to turn science and art at Aalto University into success stories in business operations and to act as a catalyst for ambitious entrepreneurship.

ACE supports ideas for new businesses by helping people prepare business plans and market surveys and obtain financing needed to set up a company. An important tool in the initial stage is Aalto Venture Garage where students, researchers and entrepreneurs who have already won their spurs develop business ideas into enterprises.

ACE has signed a partnership contract with the Stanford Technology Ventures Program (STVP) at Stanford University’s School of Engineering. The objective of the partnership is to create new innovations, jobs and companies and, at the same time, build Aalto University into Europe’s leading university in the development of entrepreneurship. The people from Stanford were greatly impressed with the strong role of Aalto University students in the development of a culture that promotes entrepreneurship.

Aalto Entrepreneurship Society (Aaltoes) and Venture Garage, both of which were launched by students, encourage young people to become entrepreneurs. With its open-minded approach, Aaltoes has emerged as an enthusiastic advocate of new and courageous growth entrepreneurship. Aaltoes and Venture Garage work in close cooperation with ACE.

which was established by students, provides strong support for a new kind of growth entrepreneurship.

Aalto University’s societal impact is also visible in alumni activities, which promote interaction between the university and its alumni as well as long-term, multifaceted cooperation. The objective is to build on the strategy of Aalto University and construct partnerships that advance the university, its alumni and society at large, and to create and develop for the alumni the potential to act as an integral part of the university community.

Alumni activities are also an active and established part of the collaboration between Aalto students and employers. This cooperation takes the form of mentoring programmes, for example.

Aalto University’s societal impact can also be seen in the leadership and continuing education it provides. For example, the goal of the Aalto Executive Education Leadership Lab is to become a unique laboratory of leadership that searches for breakthroughs by way of new, creative and engaging working methods. Such leadership and trend-setting have a lot to give to society.

Participating in the Helsinki World Design Capital 2012 year

- Helsinki is the World Design Capital in 2012 together with Espoo, Vantaa, Kauniainen and Lahti.
- Aalto University of one the key collaboration partners of the World Design Capital project.
- Aalto University’s World Design Capital year programme called Living+ creates better living environments in the spirit of sustainable development.
- The programme promotes awareness of research and teaching related to the design of living environments.
- More than 30 projects and hundreds of people from Aalto are involved: students, teachers, researchers, other personnel, and alumni.
- In addition to Finland, Living+ events are organised in, e.g. Shanghai and London.
living.aalto.fi/en
School of Arts, Design and Architecture
For useful art

The School of Arts, Design and Architecture combines design, media, architecture, motion picture, art education and art. The new school, formed by the merger of the School of Art and Design and the Department of Architecture of the School of Engineering, will carry forward the internationally recognised expertise created by its predecessors.

The new school brings together the areas of designing and implementing human-oriented environments and areas of research and teaching based on humanistic and cultural traditions. Cooperation and interaction between the different disciplines of the school challenge technology-driven thinking and put greater emphasis on a human and user-centred approach in the creation of environments.

The school’s unique character is a result of its ability to combine experience stemming from a long tradition with new thinking in a way that enables new, creative solutions. The key areas of research are design, digital media, audiovisual representation, art, visual culture, well-being, architecture and emerging technologies, and urban planning and design. The school produces specialists and innovators of art, design and architecture with strong artistic and technical skills.

The merging of the creative fields at Aalto reflects their ability to renew themselves and indicates courage to tackle global challenges: building a sustainable future, visionary urbanisation and the changing of unsuitable environments.

- 480 personnel: 60 professors
- 2,110 students: 340 doctoral students
- appr. 400 degrees awarded annually: 160 bachelor’s, 230 master’s and 10 doctoral degrees
- Departments: Architecture, Art, Design, Media, Department of Film, Television and Scenography
- Units: Media Centre Lume, Western Finland Design Centre Muova
The school was established in 1911, and until 2010 it was called the Helsinki School of Economics. Teaching is based on research in economics and excellent relations with the business world. The school offers bachelor’s, master’s and doctoral education in Finnish and English. It also provides education for experts and executives as well as courses open for everyone at the Open University. The School of Business has placed well in various rankings in its field; in 2011, for example, Financial Times ranked it as the 22nd best business school in Europe.

The School of Business unites experts from different fields in order to gain an in-depth understanding of the economy, management, consumers, different cultures and services.

- 550 personnel: 65 professors
- 3 680 students: 280 doctoral students
- appr. 1 090 degrees awarded annually: 410 bachelor’s, 315 master’s and 25 doctoral degrees and 340 MBAs/EMBAs
- Departments: Accounting, Communication, Economics, Finance, Information and Service Economy, Management and International Business, Marketing
- Units: Center of Markets in Transition - CEMAT, Center for Knowledge and Innovation Research - CKIR, Small Business Center

The Aalto University School of Business was established by a group of business pioneers a hundred years ago. Today, the school provides the most versatile environment in Finland for research and education in economics.

The school belongs to the top 1 per cent of business schools that holds the so-called Triple Crown, the three most important international quality accreditations of the field: AACSB, AMBA and EQUIS. In addition, the school is part of the esteemed CEMS and PIM networks.

The School of Business educates responsible experts to solve the problems of tomorrow. Close cooperation with businesses, and the real case approach used in teaching and research ensure that the latest knowledge is rapidly transferred to the benefit of society.
School of Chemical Technology
At the forefront of sustainable development

The particular strength of the School of Chemical Technology is combining expertise in natural sciences with engineering. The focal areas of research and teaching carried out at the school are sustainable processing and use of natural resources, energy technologies and new materials.

In its focal areas, the school focuses on improving the ecology and energy-efficiency of processing of natural resources, such as wood, other bio-masses as well as ores and minerals. It also develops new materials and applications based on the said raw materials. Examples of the areas of research at the school include the shaping of micro-organisms and enzymes, different kinds of bio-materials, new energy materials, active and functional materials as well as the manufacturing processes of bio-components for transport fuels.

The school's expertise in the processing of renewable and non-renewable raw materials constitutes a foundation for the development of different applications and cooperation with other universities, research institutions and businesses.

The strength of the School of Chemical Technology is applied technical and scientific research that benefits Finnish industry as it develops and reforms its operations. The assessment of research at Aalto University found the corporate relations of the school to be unique, even on an international level. Furthermore, the research conducted at the school creates new business opportunities.

The school responds to the environmental challenges of today through means of high-quality research and teaching, by educating responsible experts with a wide range of knowledge for the metals and electronics industry; wood processing industry; as well as the chemical, medical, biological and food industries.

In the future, teaching at the school will be focused on master's and doctoral education, particularly in its focal areas.

- 550 personnel: 40 professors
- 2 380 students: 380 doctoral students
- appr. 240 degrees awarded annually: 120 bachelor's, 95 master's and 25 licentiate or doctoral degrees
- Departments: Biotechnology and Chemical Technology, Chemistry, Materials Science and Engineering, Forest Products Technology
School of Electrical Engineering
Expertise in science and engineering

The School of Electrical Engineering is Finland’s oldest and largest university unit that carries out research in automation and systems technology as well as electronics and electrical engineering. The school is home to two Centres of Excellence in Research selected by the Academy of Finland: the Centre of Excellence in Smart Radios and Wireless Research (SMARAD) and the Centre of Excellence in Generic Intelligent Machines (GIM). The language of instruction of all the master’s programme courses of the school is English.

The research at the Aalto University School of Electrical Engineering ranges from electrical engineering and information and communication technology to selected physics applications. The research focus areas are ICT, micro- and nanotechnology and grand challenges in energy, environment, health and wellbeing.

We cover fields that are central to the Finnish export industry that needs an increasing number of well-educated experts.

Our school has several internationally unique research infrastructures, including the largest cleanroom facilities in the Nordic countries at the Micro- and Nanotechnology Centre Micronova, the 14-m telescope at the Metsähovi Radio Observatory, and a laboratory for high-voltage engineering with capacity unique in Northern Europe. The school has strong networks with business life, research organisations, and universities in Finland and abroad. Several companies have placed their research units on our premises, which facilitates close interaction between the academic research and industrial development.

- 690 personnel: 50 professors
- 3,430 students: 675 doctoral students
- Appr. 700 degrees awarded annually: 175 bachelor’s, 475 master’s, 50 licentiate and doctoral degrees
- Units: Metsähovi Radio Observatory, Micronova Centre for Micro- and Nanotechnology
School of Engineering
Expertise in technology and the built environment

The key themes of research and teaching at the School of Engineering are related to the well-being of the environment, the sufficiency and cleanliness of energy as well as the health and safety of people. The school studies and teaches fields that cover the entire built environment, including its machinery and equipment. Key areas of research are energy technology, mechanical engineering, land use sciences, civil and structural engineering, and civil and environmental engineering.

The school works in close cooperation with society. Connection of the various branches of research with the technology industry and the built environment provides researchers, teachers and students with the ability to observe and understand the big picture. Indeed, the specific task of the School of Engineering is to scientifically reform technologies related to the technology industry and the built environment and to educate experts with a wide perspective. The school creates new information, based on research, and solutions that serve the objectives of sustainable development.

The fields of engineering are characterised by a long tradition of experimental research and application-based competence. Studying the interfaces between information technology and traditional engineering sciences opens up new opportunities for research and teaching. The school takes an active part in the construction of new and innovative learning environments. One good example is the Design Factory, where new forms for cooperation are searched in an environment in which academic teams, researchers and students from various sectors collaborate with private companies and public organisations.

The research data produced is seamlessly transferred to teaching. Practically-oriented and co-financed research projects as well as theses implemented in cooperation with businesses provide researchers, teachers and students with the opportunity to witness prompt realisation of concrete outcomes of their research work. The competence of Masters of Science in Technology who graduate from the School of Engineering is highly valued in expert duties in both the business world and the public sector.

- 710 personnel: 60 professors
- 3,300 students: 300 doctoral students
- appr. 580 degrees awarded annually: 240 bachelor’s, 300 master’s, 20 licentiate and 20 doctoral degrees
- Departments: Energy Technology; Engineering Design and Production; Surveying and Planning; Civil and Structural Engineering; Applied Mechanics; Civil and Environmental Engineering
- Research institutes: Center for Energy Technology (CET); Institute of Building Services Technology
The Aalto University School of Science is famous for its excellence in both research and teaching. The high quality of research is reflected in several Centres of Excellence and Academy Professors appointed by the Academy of Finland. In addition to domestic competitive research funding, researchers at the school have obtained a significant amount of funding from the European Research Council (ERC).

The School of Science has extensive research fields. Key areas are computing and modelling, material physics, energy science, software and media technologies, technology-based business and enterprising as well as brain research and imaging technologies. The doctoral programme at the school contains a total of 21 fields of study. The School of Science produces more than 40 per cent of all the doctors graduating from Aalto University.

Interesting bachelor’s and master’s degree programmes attract talented students both from Finland and abroad. The school is also responsible for the provision of basic teaching in mathematics, physics, information technology as well as industrial engineering offered to students from all Aalto University schools of technology.

At the beginning of 2012, the school launched four strategic initiatives: The Aalto Science Institute (ASci), The Aalto University Energy Science Initiative (ESCI), The Aalto Ventures Programme (AVP) and The Aalto Brain Centre Initiative (ABC), with the aim to promote multidisciplinary activities and internationalisation at Aalto University.

The School of Science develops and maintains four important jointly used research environments. Out of these, the Nano Microscopy Center (NMC) and the Cryo-hall has received the status of a national infrastructure. The research environments for brain and neurosciences are the Advanced Magnetic Imaging (AMI) Centre and the MEG laboratory and for computational science is Science-IT, a high performance computing facility.

- 1 500 personnel: 81 professors
- 3 600 students: 1 026 doctoral students
- appr. 500 degrees awarded annually: 220 bachelor’s, 155 master’s, 12 licentiates and 54 doctoral degrees
- Departments: Biomedical Engineering and Computational Science, Mathematics and Systems Analysis, Media Technology, Applied Physics, Information and Computer Science, Computer Science and Engineering, Industrial Engineering and Management
- Units: Language Centre, O.V. Louhasmaa Laboratory, Helsinki Institute for Information Technology - HIIT
- Partnerships: EIT ICT Labs, Helsinki Institute of Physics - HIP