



**KTH Industrial Engineering  
and Management**



# Annual Report 2011

**SCHOOL OF INDUSTRIAL  
ENGINEERING AND MANAGEMENT**

**KTH  
ROYAL INSTITUTE OF TECHNOLOGY**

# KTH ITM in figures 2011

Innovation lab at the Department of Machine design

## EDUCATION

- 5 M.Sc. Engineering Programmes
- 1 B.Sc. Engineering Programme
- 9 Master Programmes, 2-years
- 4 Master Programmes, 1-year
- 2768 full time students
- 2463 full year performances
- 304 active doctoral students

### New students

- 526 students on the Master of Science in Engineering, of which 33 percent are women.
- 130 students on the Bachelor of Science in Engineering, of which 21 percent are women.
- 481 students starting Master Programmes of which 31 percent are women\*.

### Degrees

- 239 Master of Science in Engineering of which 25 percent to women.
- 75 Bachelor of Science in Engineering of which 14 percent to women.
- 268 Master degree/Master of Science, of which 29 percent to women.
- 15 Licentiate degrees of which 20 percent to women.
- 41 PhD degrees of which 32 percent to women.

\*The number of new master students 2011 includes both students who applied specifically to a Master programme, and KTH-students from a Master of Science in Engineering programme who apply for the Master programmes for the last two years of their education.

## RESEARCH

### Activity-based research:

- Behaviour and Performance of Material
- Engineering Design
- Production Engineering
- Sustainable Energy Systems
- Industrial Management

Responsibility for 14 Competence Centres.

## FINANCE

### University allocations

- MSEK 243 undergraduate education
- MSEK 125 research/doctoral studies

### External financing

- MSEK 164

### Staff (persons)

- 485 employees, of which:
  - 330 men
  - 155 women
- 54 Professors
  - 44 men
  - 10 women
- 48 Associate Professors
  - 37 men
  - 11 women

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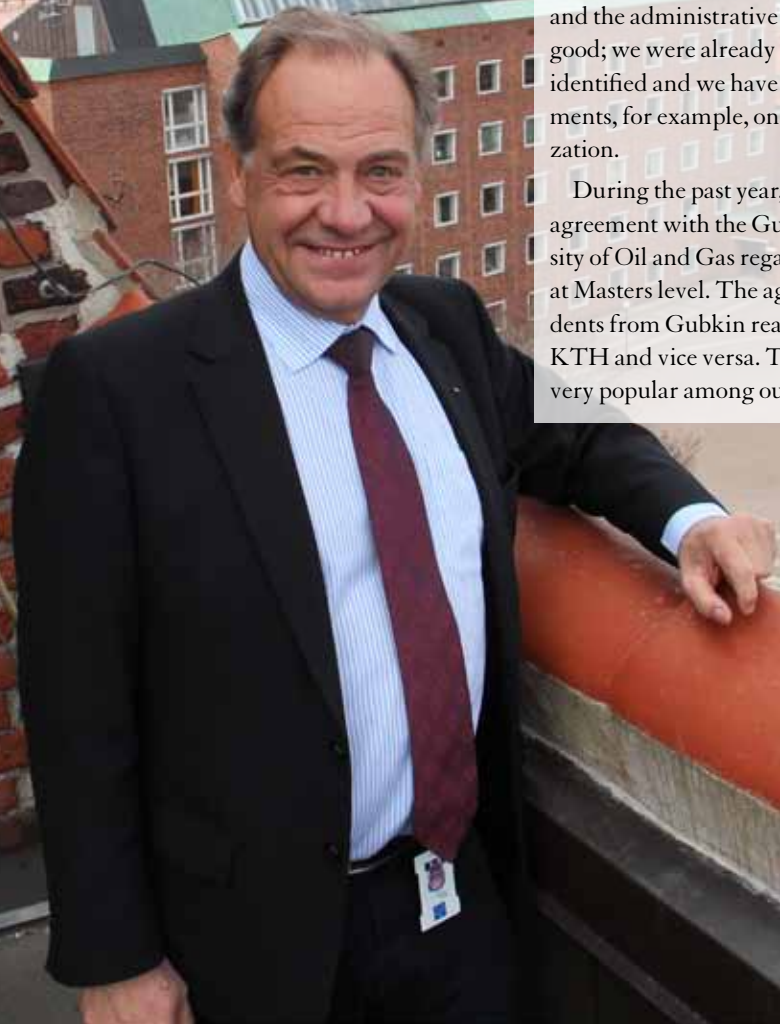
# Highlights 2011!

The School of Industrial Engineering and Management (ITM) is one of the largest schools at KTH. We operate in six departments and fourteen centers.

We have very distinguished education programmes (starting on bachelor level), with continuously high admission points. For our Master's programmes we can notice a large decline year 2011, because of the fees for non-European students, which was introduced during the year.

The School's education has been evaluated during the year in the big EAE evaluation that KTH implemented for all their training programs. The evaluation involved a lot of work that required much effort from both the academic staff and the administrative staff. The end result was good; we were already aware of the shortcomings identified and we have already begun improvements, for example, on the area of internationalization.

During the past year, the school has made an agreement with the Gubkin Russian State University of Oil and Gas regarding exchange of students at Masters level. The agreement means that students from Gubkin read parts of their education at KTH and vice versa. This agreement has proved very popular among our students.



We arranged "the S staholm-Conference" for our Ph.D. students for the third year in a row. A much appreciated event that we will continue with year 2012.

Some highlights at the departments:

- The Innovation Lab at the Department of Machine Design was inaugurated.
- I2P Global Competition, which is an early-stage technology commercialization plan competition, was hosted by the Department of Industrial Economics and Management.
- Lean Production was implemented to the undergraduate education at the Department of Applied Mechanical Engineering.
- A new machine and digital lab, within the XPRES project, was planned and started to built at the Department of Production Engineering.
- Nobel laureate Dan Shechtman held a lecture at the Department of Materials Science and Engineering.
- EIT - InnoEnergy, at the Department of Energy Technology, started 2011 with nearly 30 projects at the School.

Personally, I want to thank all of those who in various ways have been engaged in the activities at ITM. 2012 seems to be just as exciting, with new projects and activities starting, new engagements will be made and hopefully we will continue to contribute to the social and technological developments.

Bengt Lindberg  
Dean of School

Lecture by Nobel Laureate 2011, Dan Shechtman.



Inauguration of the Innovation Lab at the Department of Machine Design.



Agreement with Gubkin Russian State University of Oil and Gas.



# Research

## OUR RESEARCH

The school's research efforts are built around five major areas complemented by a number of thematic focus areas:

- Behaviour and Performance of Material
- Engineering Design
- Production Engineering
- Sustainable Energy Systems
- Industrial Management

The currently strong fields and the corresponding research has usually their main residence within one or two departments, but they build networks over departments boundaries and in some cases over school boundaries. In the longer term, these groups constitute a fundamental base of the school's efforts in various programs.

## SOME EXAMPLES FROM OUR RESEARCH

On the following pages we present some of the school's researchers / PhD-students and their research:

- Promising results in 6-DOF haptic feedback.
- A good example of unique competence applied to industry.
- Materials science – an area with an exciting future.
- We can make Sweden's production resources more efficient by increasing our proactive thinking.
- Urban resource management from a systems perspective by increasing our proactive thinking.
- Bioenergy can reduce global inequality.

Ellen Bergseth, PhD-student at the Department of Machine Design.

# Promising results in 6-DOF haptic feedback

Magnus Eriksson, PhD at Mechatronics Lab of the Royal Institute of Technology, does research in the development of a haptic surgery simulator for medical milling applications. Right now focus is put on 6-DOF haptic rendering, a unique research project at KTH.



## MAGNUS ERIKSSON PHD-STUDENT

Department of Machine Design

Magnus Eriksson started his studies in haptic at the Department of Machine Design, Mechatronics Lab in 2003.

Virtual reality and haptic feedback are still relatively new and unexplored areas, only emerging in approximately the last 15–20 years for medical applications.

”Both the high risks of training on real patients and the shift from open surgery to endoscopic procedures have spurred the introduction of haptic and virtual reality simulators for training surgeons,” says Magnus Eriksson.

Increased computer power and similarities with the successful aviation simulators have also motivated the introduction of simulators for surgical training.

**Magnus present research project** introduces the development of a haptic milling surgery simulator based on realistic 6-DOF haptic feedback.

”This includes the development of efficient 6-DOF haptic rendering for voxel-based milling operations, and also to develop a new 6-DOF haptic device based on parallel kinematics that can handle collisions between stiff rigid bodies,” says Magnus.

The research work presented in Magnus thesis deals with the development of a haptic milling surgery simulator. The main focus is put on the development of 3D visualization of the object to be milled, including object updating during the



3D visualization

milling procedure, and on the development of a 6-DOF haptic milling algorithm.

”The object to be milled can be any kind of a volumetric data object built up with voxels of density values. The voxel density values are stored in a hierarchical octree node structure, which is used for fast updating of the voxels’ density values when milling and for fast collision detection,” says Magnus.

**The 3D visualization** is performed by using a modified marching cubes algorithm, and the virtual material removal is performed by decreasing the manipulated voxel density values.

”The milling tool is created as a signed distance field, for fast collision detection and haptic feedback. Point-shell points representing the surface of the object to be milled is generated by traversing the octree and – if needed for computational reasons – applying a method for adjustable closeness of the point-shell points,” says Magnus.

**The 6-DOF haptic** milling algorithm applies a penalty-based method that uses a static virtual

coupling for stable haptic interaction and feedback. A verification test and a face validity study of the bone milling surgery simulator prototype has been performed in cooperation with the Karolinska University Hospital Division of Orthopedics.

”Interactions and discussions with Simulatorcentrum at the Karolinska University Hospital as well as with the Neuronic Engineering at KTH have been very valuable for understanding the user perspective,” says Magnus.

In November 2011 twenty-one orthopedists and residents performed a face validity test of the developed bone milling surgery simulator prototype.

”The results were promising, and are intended to be applied in future simulators used to educate and train surgeons for bone milling operations,” says Magnus.

The unique project has been funded by the Center for Technology in Health Care (CTV) at KTH and by the national Swedish research program PIEp – Product Innovation Engineering program.

# A good example of unique competence applied to industry

Pia Höök's has a long list of credentials in gender research, organization and management. Since 2007 she has been an assistant professor in the Department of Industrial Economics and Management. At the same time she is the Diversity Director at AB Volvo.



**PIA HÖÖK**  
**ASSOCIATE PROFESSOR**

Department of Industrial  
Economics and Management

Pia Höök has a long-term interest in change processes and the disparity between men and women's conditions in organizational contexts. Directly after completing her studies at the Stockholm School of Economics she began her doctoral studies under Anna Wahl, Professor in Gender, Organization and Management. With Anna Wahl as her pioneering mentor Pia completed her doctorate in 2001 with her dissertation entitled *"Fighter pilots in wide skirts – On leadership development and equal opportunity"*. Her dissertation was a study of a leadership development program for women in middle management of a major Swedish company in the engineering industry.

"My dissertation shows how concepts of leadership are based upon a male norm and how these notions are challenged and regenerated within the leadership development program. As the title suggests the picture that emerges is rather double-edged," says Pia.

**Equal opportunity and diversity** are not just issues for Swedish industry, but also for higher education. Anna Wahl formed a research group at the School of Economics to study gender, organization and management. Pia is a part of that group, which moved to KTH in 2005, to the School of Industrial Engineering and Management.



"There was a clear interest from senior management at KTH to take on this sort of research. Our group was also ready to assume greater challenges in a new, broader research environment with greater diversity," says Pia.

In conjunction with the move to KTH the research group received a large grant from Vinovna and the Swedish ESF Council in Stockholm. Pia led the project called *"Women as a source of power in change and innovation processes"*.

Pia says that the reason for the project was that women are found in fewer professions and are underrepresented in decision-making positions.

"In general women have fewer possibilities to exercise influence in work organizations and influence social development than men. This can be viewed as both a democratic and socioeconomic problem," says Pia.

KTH, AB Volvo and Vattenfall are collaborative partners in this project, which is intended to promote a process for equal opportunity and to strengthen the position of women in their own organizations.

**As a researcher Pia** has always been in close contact with industry and been a guest lecturer. She

also has experience from the government Delegation for Equal Opportunities in Higher Education and authored several books.

Since 2007 Pia has combined her role as a researcher with that of managing work with global diversity at AB Volvo. In the latter context her work includes setting strategic goals and overall guidelines for work with issues of equal opportunity within the organization.

"Within the framework for my work at AB Volvo I have developed new ways of measuring and following up work with diversity. I have also initiated a network of women on the senior management level," says Pia.

**A lot has happened since** the 1990s when Pia began doing research on gender, organization and management, and today there are several projects focused on the topic at KTH. In 2013 Pia, along with her research colleagues Sophie Linghag, Charlotte Holgersson and Klara Regnö, are coming out with a trilogy with the working title *"Gender labeled prerequisites for leadership"*. The trilogy will compile, compare and present knowledge from various sectors in an easily assimilated form.

# Materials science – an area with an exciting future

Materials science is one of KTH's strongest fields and this is where Professor John Ågren's research is on the cutting edge. An important trend in this field of research is currently the 3-dimensional characterization of the structure of materials.



**JOHN ÅGREN  
PROFESSOR**

Department of Materials  
Science and Engineering

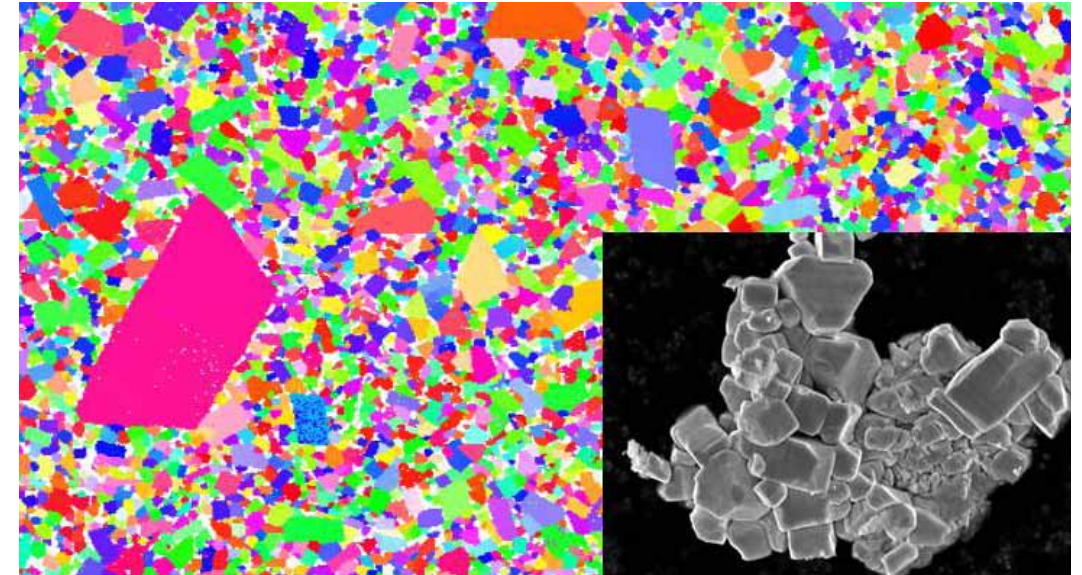
Ever since he was a child John Ågren has had a burning interest in physics and chemistry. This interest was reinforced when he began to study at KTH and discovered that materials science contained the perfect mix of physics and chemistry.

"I was especially fascinated by the way the structure of materials could be developed through various reactions and how this affected their characteristics," he relates.

John Ågren completed his doctorate in metallography in 1981 with a dissertation on mathematic modeling of structural developments in metals.

"I had the privilege of working in an area that was undeveloped, but which soon progressed dramatically and was able to follow developments closely and also be a part of them," says John.

After he completed his doctorate, John worked for a year at a research company in the USA and then came back to KTH where he was employed as a research associate. In 1990 John was appointed professor of metallography and since then has received several prizes and honors. Today John Ågren is also the Head of the Hero-M Research Center, which is involves important Swedish materials industries, such as steel and hard metal manufacturers specialized in software and development.



The picture shows the WC grains of the carbide shown with two different techniques.

## Tell us more about your field of research.

"It's about the way the micro and nano structures of materials are developed through different types of solid-phase transformations. At elevated temperatures diffusion plays an important role here. Diffusion is the disordered movement of atoms, which is temperature dependent and leads to major changes. At lower temperatures, you get transformation without diffusion due to mechanical tension and deformation processes.

I work primarily with different kinds of calculations, but also with electron microscopy. One challenge in research is to use our in-depth scientific knowledge to design new materials with better characteristics. For example steel that is stronger, tougher and corrosion resistant," says John.

## Can you describe some of your current innovations?

"We have developed a new metal alloy that can be cast in glass structures up to a thickness of 12 millimeters. That sets a world record for this type of alloy. We have also developed a new computer program that is currently being tested in industry. We often have very good collaboration with the engineering industry at KTH and can see to it that our results are useful," says John.

## What are current trends in your field?

"Right now the international Materials Genome Initiative, which president Barack Obama launched in 2011, is being discussed. This is very close to the research that we are doing at the Hero-M Research Center.

Another important trend in our field of research is the 3-dimensional characterization of materials' structures with Atom-Probe-Tomography or hard x-ray technology, both of which are used at Hero-M," says John.

## What does the future hold in this area?

"The future is a lot about new, advanced methods for characterizing and understanding the way materials are structured in 3D – from their atomic arrangement on nano and micro levels to what can be observed by the naked eye. This involves both experimental equipment such as synchrotron light and the planned European Spallation Source (ESS) in Lund, as well as theoretical techniques based on quantum mechanics and thermodynamic simulations. Personally I am hoping to launch a few other major research projects in some very exciting fields," says John.

# We can make Sweden's production resources more efficient by increasing our proactive thinking

Production technology is important for the future and is currently an expansive field. Kerstin Dencker is a doctoral student doing research on ways to increase the efficiency of Sweden's production by promoting proactive thinking.



**KERSTIN DENCKER,  
PHD-STUDENT**

Department of Production Engineering

Kerstin Dencker studied at the technical high school in Älmhult before she moved to Stockholm to work for a while in the restaurant business.

"When I was 25 I was beginning to feel that I had a bit more to give and so I started to study mechanical engineering at KTH. It was conflicting to work in a restaurant, but studying at KTH seemed more appropriate for me," Kerstin recalls.

It turned out, however, that Kerstin's career in the restaurant business was not completely over, but took another turn after her 3 years of mechanical engineering studies.

"I was asked if I could start working as a restaurant manager where I worked before, at Gamla Stans Bryggeri. After that I worked as operational manager at Grinda Wårdshus. In 2005 I longed to return to technology and began studying for an engineering degree with a major in industrial production at KTH. The step from the restaurant business to the engineering industry may seem really big, but the fact is that you work with "lean" principles every minute in a restaurant," says Kerstin.

**Tell us more about your current field of research.**

"I am doing research on ways to increase the



Machine and digital lab at the department of Production Engineering

efficiency of Sweden's production by increasing proactive thinking. Today we often change in reaction to outer demands. I would rather that we are a step ahead both in terms of operational and production development," says Kerstin.

Kerstin says that she has chosen to work in this particular field because she wants to make a difference.

There is a major potential for increasing the profitability of factories in Sweden. In this field of research we think about how society and the environment are affected in the long term, which is important for me," says Kerstin.

One of the major challenges, of course, is to get economic goals to go hand in hand with environmental goals.

"For those of us who work with industrial research it is important to listen and interpret the challenges and needs of the future. In production we have to combine various disciplines and have a holistic perspective. For example, we need to have skills in technology as well as within labor science, psychology and computer science," says Kerstin.

Kerstin thinks that knowledge transfer and exchange between academic and industrial environments are some of the advantages of being a doctoral student in industrial sciences at KTH.

"As a doctoral student in engineering at KTH

you have access to your professional network as well as to your academic network, which is very exciting," says Kerstin.

KTH and the School of Industrial Engineering and Management have world renowned competence in construction, optimization and operation of profitable production. Kerstin says that research in the field is very exciting and growing.

"Sweden has chosen to highlight production in a way that has never been done before, which is very important. Few people are aware of the fact that 20 percent of the heavy transmission equipment of the world is produced in the Mälardal region. Innovation for those of us who work with production is getting things to happen, to bring research out into industry as more effective new ways of working," says Kerstin.

**Parallel with her research,** Kerstin is also the Head of KTH's Center for Design and Management of Manufacturing Systems (DMMS). DMMS partners include Sandvik, Scania, Swerea IVF and Chalmers MCR.

"In order to secure resources for education and research and enhance collaboration between companies, colleges, universities and industrial research centers, DMMS offers a single point of contact for advanced production development activities. We initiate projects as needed and coordinate research in various areas," says Kerstin.



# Urban resource management from a systems perspective

In light of the future, industrial ecology and sustainable urban development are critical fields of research. Nils Brandt is an associate professor in Industrial Ecology at KTH Royal Institute of Technology. The focus of his research is systems-oriented applied research that is highly relevant to society.



**NILS BRANDT**  
**ASSOCIATE PROFESSOR**

Division of Industrial Ecology

Nils Brandt has a solid background as a biologist and environmental consultant for companies like NCC, Ericsson and Skanska. Over the years he has also published more than 50 books and articles for international journal and conferences. He has been working at KTH since 1989.

#### Tell us about your field of research.

”Industrial Ecology is a field of research involving systems studies of materials and energy flow in relation to sustainable development. My field is Industrial Ecology and sustainable urban development with a focus on the flow of energy and materials in cities and urban districts. Fundamentally it’s a question of urban resource management of energy, waste, consumption and transport from a systems perspective,” says Nils.

Aktiva huset, the Active House, is a project in the new eco-district, Norra Djurgårdsstaden in the Stockholm Royal Seaport. It is one of many projects where Industrial Ecology is conducting research in collaboration with other disciplines.

”The Active House is an interdisciplinary project in which we are collaborating with behavioral scientists as well as researchers in information and communication technology who are competent in the electro-technology. It involves the implemen-



Photomontage over Stockholm Royal Seaport from south east . Source: Aaro Designsystem

tation of an intelligent electrical network. Our role in the Active House is to develop a model for calculating impact on the end-user’s carbon footprint,” says Nils.

**The Active House is one of several** projects in Norra Djurgårdsstaden, a district of Stockholm, in which KTH is participating. An ambitious environmental and sustainability programme has been set up for this new district with the objective to serve as a good example of sustainable urban development and which could become one of the first climate positive urban districts. A smart electrical network is an important prerequisite for this and the building itself will become an active consumer that helps to reduce environmental impact. Environmental impact will be further reduced by investing in low energy buildings, solar cells, energy efficient transport and closed water, waste and energy cycles. The overall goal is to create a climate-adapted district by 2030 that is free from fossil fuels and where carbon dioxide emissions are less than 1.5 tons per person annually by 2020. Together with Fortum, ABB, Interactive Institute, Electrolux, JM, NCC, HSB and ByggVesta, KTH has received 10 million SEK from Sweden’s Innovation Agency, Vinnova, to create the first ”Active House” in Norra Djurgårdsstaden.

”KTH has developed a calculation model for the Clinton Climate Initiative used to analyze and describe the development of a climate positive district, with Stockholm Royal Seaport as a point of departure. In this context we are also working on an interdisciplinary project supported by Vinnova for the purpose of following up the sustainability programme. Here we are investigating the possibilities for an information system based on IT and communication technology. We are looking at how information and communication technology can be used to handle energy and material flow data in order to enable dynamic and interactive follow-up on different levels – from the level of the household to that of an entire district. We envision a transparent information system that can generate major possibilities,” says Nils.

# Bioenergy can reduce global inequality

Henrique Pacini, doctoral student, believes that bioenergy can meet some of the major challenges to modern society. To this end he is implementing his research directly on the world market within the framework for a collaborative agreement between KTH and UNCTAD. His focus is on the effects of EU's sustainability criteria for biofuel.



**HENRIQUE PACINI**  
PHD-STUDENT

Department of Energy Technology

## Tell us more about your field of research.

"My research focuses on the effect that EU's sustainability criteria for biofuel will have – and are already having – on the bioethanol markets. I have chosen EU's criteria since the EU has been a policy leader in the field of biofuels. I have chosen bioethanol in particular since it is the biofuel that is traded most in the world. It is also an important export product in my home country, Brazil," says Henrique.

There are three fundamental parts of Henrique's research. The first part investigates how consumers choose their fuel, based upon the cost of biofuels relative to fossil fuels. In the second part he analyzes the effects of EU's biofuel policy with regard to ethanol markets, using Brazil as a case study.

"Right now I am working on the third part, which is to identify a price for sustainable development by mapping the added cost for certified ethanol in relation to conventional ethanol. Based on the results of my study of consumer behavior I will make recommendations," says Henrique.

Beyond his primary research, work for the UN is giving Henrique insight into the concrete political dialogue among countries such as Mexico, Brazil, Argentina and Mozambique.

"In this context I can also participate in discus-



sions about and the development of certification systems for biofuels. It is really stimulating that the results of my doctoral dissertation will result in concrete political advice. KTH's interdisciplinary flexibility and international contacts have been instrumental in making this possible," says Henrique.

## Why have you chosen to work in the field of bioenergy?

"I believe that bioenergy is capable of meeting some of the major challenges we face in modern times. To begin with, there are not very many pure energy solutions that offer good value to consumers, especially not in the transport sector. Secondly, bioenergy can reduce global inequality. Several developing countries are well-equipped to be producers and technology developers in this area," he says.

"There is currently a major demand for specialists in renewable energy and I believe that the demand will grow in the future," says Henrique.

"There is a great need for people who can understand both the technical and the political aspects of energy systems, since both are decisive for generating research results," says Henrique.

## What else is happening in your field right now?

"A lot of technology is being developed that will make biofuels a better alternative to gasoline, die-

sel and natural gas. Biofuels produced from algae or based on cellulose have a potentially much greater availability, and considerably reduce the risk of conflict between ecological and social systems. At the same time, regulations are being developed and an entire field of sustainability certification for biofuels has emerged. Since we still know very little about how certification affects biofuel producers, there is a lot of potential for research," says Henrique.

## What does the future hold in this area?

"As a consequence of industrial policy and climate change many countries are investigating alternatives in order to reduce their dependency and secure energy. This makes areas that work with biomass very promising for future research," says Henrique.

## What about your own plans for the future?

"I am beginning to prepare to defend my dissertation, but I am looking farther ahead too. As a doctoral student at KTH I have the advantage of receiving a world class education in a country that is on the leading edge when it comes to research on renewable energy. In the future I would like to pay back what this society has invested in me by building bridges between the academic world and the market, and between countries," Henrique concludes.

# CONFERENCES

The school has arranged 30 conferences/workshops/events during the year. The most visited conference/event with nearly 100 participants was I2P Global Competition.

## I2P GLOBAL COMPETITION 2011 IN STOCKHOLM, NOV 17-19 AT KTH



Professor Terrence Brown, the initiator of the I2P event.

The event was hosted by the Department of Industrial Economics and Management (INDEK)

The I2P® Global Competition is an early-stage technology commercialization plan competition hosted by the Department of Industrial Economics and Management.

At I2P® Global, invited universities from Australia, Europe, Africa, North and Latin America compete for cash prizes and a chance to enter the Texas Venture Labs Investment Competition (formerly the MOOTCORP® Competition).

### CONFERENCES AND WORKSHOPS AT THE SCHOOL 2011

- The I2P® Global Competition
- Multilayer project meeting/ conference 29-31 mars
- ConforM-Jet project meeting/ conference 8-10 nov
- Workshop i FFI Feature based operation planning 23 nov
- PVC/DMMS 8 november
- Workshop i FFI Robust machining, 15 juni and 7 dec
- Workshop i FFI Sustainable gear transmission realization, 27-28 april and 5-6 okt
- Workshop in FFI Line information system architecture 26-27 okt
- Supervisor meeting The Swedish Faculty for Design Research and Research Education (DI)
- Workshop Umea, DI
- Workshop London, DI
- Workshop KIH, DI
- Workshop Malmo, DI
- Strategic Workshop, DI
- PIEp Research seminar
- PIEp ISIAG
- ICES MSc Working Day
- ICES Lean Architecting (with Scania)
- ICES Power Management (with Enea)
- ICES Student Lunch with Prevas
- ICES System Modelling
- ICES Annual Conference 4
- ICES KTH Lab Tour
- ICES Architecting (with EISbySemcon)
- ICES at ECS 2011
- ICES Inside Ericsson Tour
- ICES Debugging with Enea 2011
- Special session 6th Dubrovnik Conference on Sustainable Development of Energy, Water and Environment Systems

# NEW PROFESSORS, PRICES, AWARDS

During 2011 four new professors have been promoted at the school. Two researchers have been awarded/received prestigious scholarships.

## NEW PROFESSORS

**Anna Delin**  
Computational Nanomagnetism

**Sergei Glavatskikh,**  
Machine Elements

**Monica Lindgren,**  
Industrial Economics and Management

**Conrad Luttrupp,**  
Machine Design

**Andrei Ruban,**  
Material Theory for Metallic Alloys



Anna Delin, new professor in Computational Nanomagnetism.

## PRIZES/AWARDS DURING THE YEAR

### Wallander award

Gustav Martinsson has been awarded a three-year postdoctoral scholarship (Wallander scholarship) from the Jan Wallander and Tom Hedelius foundation.

### Scholarship for research in production engineering from Alde Nilssons ABB-foundation

Danfang Chen, PhD-student at the department of Production Engineering received the award from Alde Nilssons ABB-fundations.



Danfang Chen receiving the Alde Nilsson award.

# Doctoral Studies

## DOCTORAL PROGRAMMES

- Energy and Environmental Systems
- Industrial Economics and Management
- Production Engineering
- Machine Design
- Materials Science and Engineering

Postgraduate studies for PhD and Licentiate of Engineering within the ITM School are conducted within the main topics of Production Engineering, Machine Design, Materials Science and Engineering, Energy and Environmental Systems and Industrial Economics and Management.

### ITM Graduate School

ITM graduate school co-ordinates postgraduate education throughout the five doctoral programs of the school through diversity of disciplines, including basic as well as applied research related to significant segments of the Swedish industry e.g. the steel, automotive, engineering and energy-related industries. The PhD programs also include analyses of industrial and technical change, innovations, management and design of technologies, processes and firms. One of the aims of the ITM graduate school is to continually strive to maintain and improve the quality of graduate education and secure research excellence as well as strong sustainability dimensions in PhD programs.

The PhD programs at the ITM School thus combines high specialization within important fields of research at KTH with an integrated, industrial and cross disciplinary approach.

### European Doctorate in Industrial Management - EDIM

The department of Industrial Economics and Management, was selected for a new PhD program- European Doctor in Industrial Management (EDIM) - by the European Union for funding under the 2010 Erasmus Mundus Action 1 Call.

# Statistics

## NEWLY ACCEPTED, REGISTERED (31TH DEC) AND GRADUATED RESEARCH STUDENTS 2009 - 2011

Figure 3

2011

Students per department	Newly accepted 2011		Registered, 31th dec		Licentiates 2011		Doctorates 2011	
	Total	of which women	Total	of which women	Total	of which women	Total	of which women
Energy Technology	18	5	83	19	6	1	6	1
Industrial Economics and Management	14	8	55	21	-	-	5	4
Production Engineering	12	1	51	4	2	-	3	1
Machine Design	11	3	34	7	-	-	6	0
Materials Science and Engineering	32	11	141	33	7	2	20	6
Industrial Ecology	-	-	29	15	-	-	1	1
<b>Total</b>	<b>87</b>	<b>28</b>	<b>393</b>	<b>99</b>	<b>16</b>	<b>3</b>	<b>44</b>	<b>15</b>

2010

Students per department	Newly accepted 2010		Registered, 31th dec		Licentiates 2010		Doctorates 2010	
	Total	of which women	Total	of which women	Total	of which women	Total	of which women
Energy Technology	12	3	49	14	3	1	2	1
Industrial Economics and Management	10	5	27	15	-	-	8	1
Production Engineering	7	1	44	4	2	-	2	-
Machine Design	9	1	33	6	4	-	3	1
Materials Science and Engineering	29	7	140	36	11	3	17	8
Industrial Ecology	3	3	26	12	2	1	-	-
<b>Total</b>	<b>70</b>	<b>20</b>	<b>319</b>	<b>87</b>	<b>22</b>	<b>5</b>	<b>32</b>	<b>11</b>

2009

Students per department	Newly accepted 2009		Registered, 31th dec		Licentiates 2009		Doctorates 2009	
	Total	of which women	Total	of which women	Total	of which women	Total	of which women
Energy Technology	23	4	69	13	3	2	3	1
Industrial Economics and Management	6	2	35	17	1	-	9	6
Production Engineering	5	-	32	3	5	3	2	-
Machine Design	9	2	34	6	9	1	5	-
Materials Science and Engineering	34	9	111	32	11	6	18	4
Industrial Ecology	1	1	20	10	-	-	-	-
<b>Total</b>	<b>78</b>	<b>18</b>	<b>301</b>	<b>81</b>	<b>29</b>	<b>12</b>	<b>37</b>	<b>11</b>

## KICK-OFF FOR THE FIRST PHD-STUDENTS AT THE EDIM PROGRAMME - EUROPEAN DOCTORATE IN INDUSTRIAL MANAGEMENT

In april 2011 the first PhD-students in the EDIM-programme, were welcomed with a kick-off. EDIM is a four-year state-of-the-art doctoral research program for doctoral training addressing managerial issues of significance for the future competitiveness and sustainability of the industrial companies of Europe.



Programme manager Cali Nuur welcomes the participants.

Starting with a kick-off the new PhD-students enrolled in the new EDIM-program where welcomed. Speakers at the kick-off where among others Sophia Hober, Dean of faculty and Cali Nuur, Programme Manager.

EDIM is run by a consortium consisting of the industrial management departments of the most prominent and well-respected engineering universities in Sweden, Italy, and Spain:

- KTH Royal Institute of Technology, Sweden.
- Universidad Polytechnica de Madrid, UPM, Spain.
- Politecnico di Milano, POLIMI, Italy.

The Programme is coordinated by the Department of Industrial Economics and Management and it is run in a consortium with three other European universities.

The ambition is to produce doctors with a new European profile reflecting a wide scientific and international breadth in engineering and management



Participants and researchers/teachers in the EDIM-programme.

# Education

## EDUCATION AT FIRST AND SECOND LEVEL

### Programmes

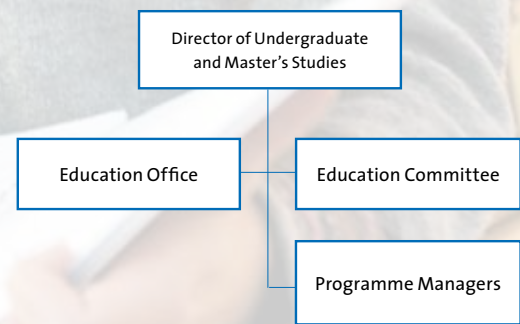
The school has five Master of Science in Engineering programs located at KTH Campus, Stockholm. One Bachelor of Science Programs, located at KTH Södertälje. Nine 2-year Master's Programme and four 1-year Master's Programmes. The Master's programmes are located at both Campus'. The school also has a Technical Preparatory Year and Technical Preparatory Semester located at KTH Södertälje. Connected to the school there are also two Erasmus Mundus Programmes.

### Teaching language

The teaching language is Swedish for the School's Bachelor of Science Programme, and the first three years at the Master of Science Programmes. Master Programmes and the last two years at the Master of Science Programmes are conducted in English.

### Organisation

The Director of Undergraduate and Master's studies leads the operation of the education at the school, reporting directly to the Dean. As a support the Director has an Education Committee consisting of the Programme Managers, student representatives, the Head of Education Office and the Director of Doctoral studies



## PROGRAMMES AT FIRST AND SECOND LEVEL

### Bachelor of Science in Engineering, 180 credits

- Mechanical Engineering

### Master of Science in Engineering, 300 credits

- Design and Product Realisation
- Energy and Environment
- Industrial Engineering and Management
- Mechanical Engineering
- Materials Design and Engineering

### Master's programmes, 120 credits

- Economics of Innovation and Growth
- Engineering Materials Science
- Engineering Design
- Industrial Management
- Innovative Sustainable Energy Engineering
- Integrated Product Design
- Production Engineering and Management
- Sustainable Energy Engineering
- Sustainable Technology

### Master's programmes, 60 credits

- Entrepreneurship and Innovation Management
- Project Management and Operational Development
- Applied Logistics (in Swedish)

### Erasmus Mundus Master's Programmes, 120 credits

- Environmental Pathways for Sustainable Energy Systems
- Aeromechanics

### Technical Preparatory Year, Technical Preparatory Semester

Supplementary training for Those who lack scientific competence. The courses are tailor made for further studies at KTH.

### Education Office

The Education Office is responsible for a wide range of student-related services for undergraduate and graduated students, as well as the administration of degree courses and examination processes.

### Presentation of a Programme Manager

On the next page (28-29) we introduce one of our Programme Managers.

# Education with strong ties to industry

Alexander Engström is Programme Manager of the Mechanical Engineering Programme at KTH in Södertälje. The principles of Lean Production are integrated into the field of Production Technology and thanks to close collaboration with Scania it is easy to show how "Lean" works in practice.



## ALEXANDER ENGSTRÖM LECTURER

Programme Manager,  
Mechanical Engineering, 180 hp

Materials and Manufacturing Technology at KTH. During the startup of a new college of engineering he was recruited to Södertälje municipality for a few years, but has been back at KTH since 2009 and teaching Materials and Production Technology. Today he also teaches courses in Lean production and as of this year he is Programme Manager of the Mechanical Engineering programme. There are three specialisations of the programme: Industrial Economics & Production, Innovation & Design and Robotics and Mechatronics.

"This fall we are starting up a new specialisation focused on safety and management of advanced systems. There's currently a major need for people with this competence, especially in the nuclear energy industry, but systematic thinking can of course be applied to other sectors as well, such as the paper industry or the petrochemical industry," says Alexander.

**Regardless of specialisation,** the Department of Applied Mechanical Engineering works closely with trade and industry, particularly with Scania, which is across the street. Alexander says that he can smell production when Scania is in operation.

"Our students work with all levels of industrial production from their very first day of school, from study visits to lab exercises and degree pro-

Alexander Engström took his Master's in Engineering from the Lund University in the mid-nineties, during a decline in industrial economy and consequent shortage of work. That's why he turned to teaching and a job as a high school teacher in math, physics, programming and technology. The teaching profession obviously suited Alexander and so he moved on to teach physics and computer science for the International Baccalaureate (IB) programme in Södertälje, where he was eventually put in charge of the subject.

In 2004 he was offered an assignment to teach



KTH Södertälje

jects. There are, of course, many advantages of working so close to industry, especially when a teacher like me wants to use practical examples and applications in teaching," says Alexander.

Since resource efficient production, so-called Lean production, is now integrated into the field of Production Technology – and given the intimate collaboration we have between Mechanical Engineering and Scania – it is easy to show how "Lean" is put into practice.

"Lean production is a subject in demand and Scania is truly exemplary," says Alexander.

Alexander has an obvious passion and natural commitment to his field, which also comes through in his teaching.

"I try to enliven my teaching and like to find concrete examples from everyday life. When it comes to corrosion, for example, I usually show some beautiful color photos of a Ferris wheel in Vienna. I took the photos of its rusty spokes when I was on my honeymoon in Vienna," says Alexander.

### What is most fun about being a teacher?

"Meeting the students is what is most fun, and of course my passion for the subjects. The history of technology is one of my favorites and I collect models of the Ford Model T in my free time. I've already managed to collect three," says Alexander.

Alexander likes to learn from history, but he is also curious about the future.

"In the future I'd like to find a field of research in production technology. It would be such incredible fun and interesting to go deeper into a specific topic," says Alexander.

### MECHANICAL ENGINEERING 180 HP

The program begins with basic mechanical engineering courses that provide the base to the four specializations that the student can choose from:

- **Industrial Economics and Production** - The specialization combines traditional engineering courses with quality engineering, marketing, logistics, accounting and law. The specialization allows the student to immerse himself/herself in business or market-based goods and services production.
- **Innovation and Industrial Design** - The specialization trains the student to formulate and present ideas and solutions, and to find new approaches to problem solving. The student has the opportunity to profile himself/herself either to design and layout, or construction.
- **Robotics and Mechatronics** - To develop smart products and services the student needs not only knowledge in mechanical engineering, electronics and computer science but also knowledge of the interface between electronics and mechanics.
- **Security and Management of Advanced Systems** - The specialization will give the student skills and knowledge he/she needs to work with the management in our key industries. In particular, the student will acquire unique skills of how organizational, social and cultural contexts and developments affect security in the industry and how to act in case of deviation from normal operation.

# Statistics



## NEW STUDENTS 2011

The amount of applicants to the school's undergraduate programmes remains high.

### Bachelor of Science in Engineering

The school's three-year programme in Mechanical Engineering has roughly the same number of students registered as in the previous year.

In the year of 2011 the Bachelor of Electrical Engineering programme became a specialization within the Bachelor of Mechanical Engineering programme.

### Master of Science in Engineering

The school's five-year Master of Science in Engineering programme has a continued high number of applicants with a high amount of credits required for admission.

Paying particular attention to Materials Design and Engineering which have an increased admission score from 14.0 (in year 2010) to 18.50 (in year 2011) of 22.50 possible.

### Master's programmes

2011 was the first year when KTH (and other universities in Sweden), started with fees for foreign students from outside the EU.

The applicants to the school's master declined by about 75%, which mainly depends on the new fees.

The school accepted 35 paying students to the school's master's programme, of which 19 got a scholarship.

2011 var det första året då KTH (och övriga universitet i Sverige) införde avgifter för utländska studenter utanför EU.

Figure 1, new students.

	2011		2010		2009		2008	
	Total	of which women	Total	of which women	Total	of which women	Total	of which women
<b>Master of Science in Engineering, Degree Programme 270/300 HE credits</b>								
Design and Product Realisation	110	46%	109	48%	111	48%	100	53%
Energy and Environment	74	57%	53	47%	--	--	--	--
Industrial Engineering and Management	147	28%	142	27%	143	36%	135	28%
Mechanical Engineering	153	21%	142	16%	141	19%	132	23%
Materials Design and Engineering	42	20%	47	17%	48	35%	42	31%
<b>Sub-total</b>	<b>526</b>	<b>33%</b>	<b>493</b>	<b>29%</b>	<b>443</b>	<b>33%</b>	<b>409</b>	<b>33%</b>
<b>Bachelor of Science in Engineering, Degree programme 180 HE credits</b>								
Electrical Engineering	- <sup>1</sup>	-	11	9%	28	7%	19	21%
Mechanical Engineering	130	21%	102	12%	108	23%	85	19%
<b>Sub-total</b>	<b>130</b>	<b>21%</b>	<b>113</b>	<b>12%</b>	<b>135</b>	<b>20%</b>	<b>103</b>	<b>24%</b>
<b>Masters programmes</b>								
Masters programmes 120 HE credits	412 <sup>2</sup>	32%	478	24%	414	21%	512	25%
Masters programmes 60 HE credits	69	26%	64	38%	187	15%	160	22%
<b>Sub-total</b>	<b>481</b>	<b>31%</b>	<b>542</b>	<b>26%</b>	<b>601</b>	<b>19%</b>	<b>672</b>	<b>24%</b>
<b>Technical Preparatory Year, Technical Preparatory Semester</b>								
	133	16%	140	22%	135	24%	67	28%
<b>TOTAL</b>	<b>1158</b>	<b>29%</b>	<b>1288</b>	<b>25%</b>	<b>1314</b>	<b>24%</b>	<b>1251</b>	<b>27%</b>

- 1) In the year of 2011 the Bachelor of Electrical Engineering programme became a specialization within the Bachelor of Mechanical Engineering programme.
- 2) The number of new master students 2011 includes both students who applied specifically to a Master programme, and KTH-students from a Master of Science in Engineering programme who apply for the Master programmes for the last two years of their education.



# Statistics



## FIRST DEGREES 2008-2011

The number of graduates from the Master of Science in Engineering programmes has decreased since 2010. One of the reasons for this is that the school's education office had been working with the "Kick-off" project throughout that year, but not during 2011.

For degrees in Bachelor of Science in Engineering we can notice a little increase.

The number of students acquiring Master's degrees has increased even this year due to an increased number of admissions in 2008 and 2009.

Figure 2, first degrees.

	2011		2010		2009		2008	
	Total	of which women	Total	of which women	Total	of which women	Total	of which women
<b>Degree of Master of Science in Engineering 270/300 HE credits</b>	<b>239</b>	<b>25%</b>	<b>393<sup>1</sup></b>	<b>29%</b>	<b>317</b>	<b>29%</b>	<b>273</b>	<b>23%</b>
Design and Product Realisation	55	42%	79	47%	46	27%	34	32%
Industrial Engineering and Management	76	22%	125	35%	103	48%	99	23%
Mechanical Engineering	85	20%	143	15%	131	15%	108	18%
Materials Design and Engineering	23	9%	38	29%	29	31%	16	38%
Materials Engineering <sup>2</sup>	- <sup>2</sup>	-	8	13%	8	25%	16	25%
<b>Degree of Bachelor of Science in Engineering</b>	<b>75</b>	<b>14%</b>	<b>59</b>	<b>36%</b>	<b>64</b>	<b>23%</b>	<b>84</b>	<b>22%</b>
Electrical Engineering	15	7%	6	50%	14	0%	22	5%
Mechanical Engineering	60	16%	53	34%	50	30%	62	29%
Degree of Master of Science (Two years)	183	29%	151	33%	78	14%	21	14%
Degree of Master of Science (One Year)	85	28%	94	27%	37	38%	11	55%

1) The number of Master of Science degrees increased by more than 100 from 2009 to 2010. One of the main reasons for this was that the school's educational office worked with the "Kick-off project" throughout the year.

2) The programme is discontinued and has not had any admission since 2002. Any degrees from the program will, starting 2011, be included in the presentation of degrees from the Materials Design and Engineering programme.

# Our School



Some of the personnel at the Education Office

## ORGANISATION

### MANAGEMENT

The School is organised into departments, competence centres, and Deans' Office. The various departments, centres all report to the School. The School is led by a Dean and Assistant Dean who report directly to the President of KTH.

#### Strategic Council

The Dean leads operations reporting to the School Board with the assistance of an Vice Dean. The School Board takes up general research, education and quality issues. This group consists of the Dean, five teacher representatives, a representative for technical / administrative staff, three student representatives, one member representing other schools, and two representatives from the industry.

#### Management Group

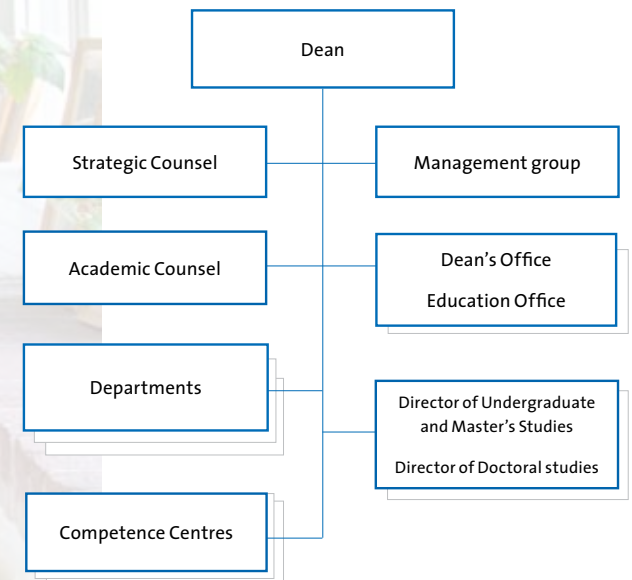
The Management Group deal with general school matters and consists of the Dean, Vice Dean, Head of Departments, Director of Undergraduate and Masters' studies, Director of Doctoral studies, Head of Administration, and Head of Educational Office

#### Academic Counsel

As a supporting role the school has established an Academic Counsel, which are chosen among PhD teachers at the school. A total of some 30 people is connected to the forum.

#### Director of Undergraduate and Master's studies

Director of Undergraduate and Masters' studies consult with an Education Committee, consisting of Director of Doctoral studies, programme managers for the various education programs, Head of Educational Office, program student (PAS) and PhD student representative.



#### Director of Doctoral studies

Director of Doctoral studies examines proposals for the certificate committee, opponents and foreign applicants for postgraduate studies, coordinates the graduate courses over department borders and decides on the establishment of postgraduate courses. The Director is responsible for the quality of postgraduate education and the graduate school.

#### Deans Office

Deans Office is coordinated by an Administrative Director. The office has four basic functions:

1. Education
2. Human Resources
3. Finance, Accounting, Controller and Procurement
4. Public Relations

## DEPARTMENTS AND DIVISIONS

Within the school, there are six departments where the school's educational activities and research is conducted. Five of the departments are located at KTH Campus and one at KTH Södertälje. The school also has a free standing division with education and research.

### Applied Mechanical Engineering

#### Energy Technology

- Applied Thermodynamics and Refrigeration
- Heat and Power Technology
- Energy and Climate Studies
- Sustainable Building Systems

#### Industrial Economics and Management

- Energy Business
- Gender, Organisation and Management
- Industrial Work Science
- Industrial Dynamics
- Industrial Economics and Management
- Management control and Corporate finance
- Economics

#### Machine Design

- Combustion Engineering
- Integrated Product Development
- Mechatronics
- Systems and component design

### Division of Economics

During 2011 ITM got a new division, the Division of Economics. The division was previously organized to the School of Architecture and the Built Environment. Now it belongs to the department of Industrial Economics and Management, at our school.

### Materials Science and Engineering

- Applied Material Physics
- Applied Process Metallurgy
- Casting of Metals
- Ceramics
- Computational Thermodynamics
- Energy and Furnace Technology
- Engineering Material Physics
- Materials Process Science
- Materials Technology
- Mechanical Metallurgy
- Micro modeling
- Physical Metallurgy

### Production Engineering

- Computer Systems for Design and Manufacturing
- Materials forming
- Machine and process technology
- Metrology and optics
- Production systems

### Stand alone division

- Industrial Ecology

## COMPETENCE CENTRES

Research at Competence Centres addresses, above all, newer subject areas; these efforts are often conducted in joint projects with business life and various societal bodies. A Centre may be connected to a certain department but still conduct research on its own.

Most of them have their own Board, with representatives from trade, business and society; others are autonomous Units directly subordinate to the KTH President. The majority of our Centres are maintaining close connections with the industry. Some of them are also acting as liaison offices between KTH and other universities.

There are 13 centres connected to the school.

### CENTRES

- Applied R&D in Refrigeration and Heat Pump Technology (effsys 2)
- Brinell Center
- Centre for Internal Combustion Engine research Opus (Cicero)
- Centre for Sustainable Development (CHU)
- Design and Management of Manufacturing Systems (DMMS)
- Innovative Centre for Embedded Systems
- Joint Center for Industrial Ecology
- KTH China Energy Center
- KTH Leacentrum
- Product innovation Engineering Program (PIE-p)
- VinnExcellence center for Hierarchic engineering of industrial materials (HERO-M)
- The Swedish Faculty for Design Research and Research Education
- Turbo-power – electric current production from thermal turbo engines & processes GTC)



The monthly recurring lunch for the staff at the Department of Industrial Economics and Management

# STAFF STRUCTURE

## STATISTICS OVER THE SCHOOLS PERSONNEL

### NUMBER OF EMPLOYED PERSONS

	Total 2011	Of which women	Total 2010	Of which women
Researchers	107	33	110	30
Ph.D Students	126	33	132	36
Professors	54	10	43	6
Lecturers	53	9	57	12
Associate professors	48	11	49	11
Administrators	72	58	70	62
Technicians	25	1	29	1
<b>TOTAL</b>	<b>485</b>	<b>155</b>	<b>490</b>	<b>158</b>

### FULL-TIME EQUIVALENTS

Full-time equivalent per unit	2011	2010	2009	2008
Deans Office	40,05	43,11	39,44*	21,1
Competence centres	5,11	0,98	1,88	11,7
Industrial Ecology	28,93	25,98	24,29	23,0
Energy Technology	74,44	67,06	56,75	59,1
Industrial Economics and Management	60,05	51,31	46,63	57,8
Production Engineering	45,43	38,90	60,69	66,6
Machine Design	70,24	63,80	35,37	25,5
Materials Science and Engineering	58,84	58,94	59,17	63,4
Applied Mechanical Engineering	23,30	23,00	23,61	33,2
<b>TOTAL</b>	<b>409,39</b>	<b>373,08</b>	<b>348,18</b>	<b>361,6</b>

\* New administrative structures, administration centralised 2009 and reported separately.

Full-time equivalent positions	2011	2010	2009	2008
Researchers	77,94	65,05	59,40	48,82
Ph.D Students	113,43	103,84	88,14	93,65
Professors	38,62	34,36	35,10	35,75
Lecturers	50,92	45,00	46,57	52,95
Associate professors	34,70	34,69	38,00	34,35
Administrators	61,97	61,06	55,19	55,46
Technicians	25,97	24,76	24,90	22,97
Others	0	0	0,80	16,71
<b>TOTAL</b>	<b>403,55</b>	<b>368,76</b>	<b>348,18</b>	<b>361,67</b>

# FINANCIAL SUMMARY

## PROFIT AND LOSS STATEMENT

All amounts reported in thousand SEK\*

	2011	2010	2009	2008
<b>Operational revenues</b>				
Basic education funding	242 931	243 123	174 367	163 563
Research grants	124 841	126 981	91 584	92 405
Grants from external funders	164 577	120 423	125 310	121 199
Revenues from charges and other fees	10 186	9 067	14 110	9 221
Other income	33 095	39 173	30 040	31 140
Financial income	903	62	245	32
<b>Total operational revenues</b>	<b>576 533</b>	<b>538 833</b>	<b>435 659</b>	<b>417 563</b>
<b>Operational costs</b>				
Staff costs	-282 899	-249 222	-232 982	-225 033
Local Costs	-74 677	-64 464	-63 411	-64 529
Travel and subsistence	-21 105	-18 926	-17 992	-14 616
Equipment excluding deprec	-9 868	-12 812	-5 585	-4 850
Consultancy	-31 476	-32 203	-26 808	-14 725
Operating and other	-25 997	-28 112	-33 589	-31 134
Common costs	-95 897	-89 859	-56 108	-56 458
Depreciation	-9 012	-7 979	-8 310	-8 554
Financial expenses	-73	-14	-224	-834
<b>Total operational costs</b>	<b>-551 005</b>	<b>-503 595</b>	<b>-445 014</b>	<b>-420 736</b>
<b>Operational outcome</b>	<b>25 528</b>	<b>35 238</b>	<b>-9 355</b>	<b>-3 173</b>
Funds received for funding	31 670	31 763	29 028	21 890
Grants funded	-31 670	-31 763	-29 028	-21 890
<b>CHANGES TO CAPITAL</b>	<b>25 528</b>	<b>35 237</b>	<b>-9 355</b>	<b>-3 173</b>

## BALANCE SHEET

All amounts reported in thousand SEK\*

	2011	2010	2009	2008
<b>Assets</b>	<b>175 540</b>	<b>147 046</b>	<b>124 975</b>	<b>101 583</b>
Fixed assets	32 953	19 535	22 291	22 587
Accounts receivable	10 413	15 292	7 291	6 573
Contract claims	0	0	0	0
Other receivables	1 005	973	392	714
Cut-outs	48 332	42 547	60 323	58 680
Cash, money order and bank	82 834	68 698	34 677	13 027
<b>Government agency capital</b>	<b>-175 540</b>	<b>-147 046</b>	<b>-124 975</b>	<b>-101 583</b>
Government capital	-24 160	4 387	39 624	26 018
Authority capital from prev. year	1 366	4 387	30 269	26 018
Authority capital year	-25 527	0	9 355	0
<b>Liabilities</b>	<b>-151 379</b>	<b>-151 433</b>	<b>-164 600</b>	<b>-127 602</b>
Accounts payable	-14 134	-12 585	-5 922	-7 583
Other liabilities	445	481	-620	-1 049
Accruals	-8 762	-9 405	-9 575	-7 366
Unused external resources	-128 325	-129 923	-132 597	-100 916
Deferred revenue	-602	0	-800	0
Unallocated fund	0	0	-15 085	-10 686
<b>TOTAL ASSETS</b>	<b>175 540</b>	<b>147 046</b>	<b>124 975</b>	<b>101 583</b>

# LICENTIATE THESES\*

## ENERGY TECHNOLOGY

ACUNA SEQUERA, JOSÉ  
Improvements of U-pipe Borehole Heat Exchangers

MAINALI, BRIJESH  
Renewable Energy Market for Rural Electrification in Developing Countries: Country Case Nepal

MÖLLERYD, BENGT A  
An anatomy of technology innovation in infrastructure and defence systems in Sweden after the Cold War

NOOR, HINA  
Preliminary Design Investigations for the Selection of Optimum Reaction Degree for 1st Stage of a High Pressure Gas Turbine

SIMANIC, BRANCO  
Energy Auditing and Efficiency in a Chain Hotel - the Case of Scandic, Järva Krog

SPELLING, JAMES  
Steam Turbine Optimisation for Solar Thermal Power Plant Operation

## MACHINE DESIGN

QAMAR, AHSAN  
An Integrated Approach Towards Model-Based Mechatronic Design

## MATERIALS SCIENCE

AL-ZOUBI, NOURA  
Describing Interstitials in Close-packed Lattices: First-principles Study

DELCZEG, ERNA  
Energy relevant materials: investigations based on first principles.

DELCZEG, LORAND  
Ab Initio Description of Mono-Vacancies in Metals and Alloys

LI, CHUN-MEI  
Elastic Properties and Phase Stability of Shape Memory Alloys from First-Principles Theory

## METALLURGICAL PROCESS SCIENCE

ALEVANAU, ALIAKSANDR  
Study of the Apparent kinetics of Biomass Gasification Using High-Temperature Steam

DAHLIN, ANDERS  
Influence of Ladle-slag Additions on BOF-Process Parameters

JELKINA ALBERTSSON, GALINA  
Investigations of Stabilization of Cr in Spinel Phase in Chromium-Containing Slags

## PRODUCTION ENGINEERING

AKILLIOGLU, HAKAN  
Evolvable Production Systems: Demand Responsive Planning

LINDQVIST, RICHARD  
Geometrical and dimensional Measurement Planning - a systematic and holistic approach

\* The amount of theses defended does not necessarily correspond to the amount of exam granted in the same year.

# DOCTORAL THESES\*

## ENERGY TECHNOLOGY

ALI, RASHID  
Phase change phenomena during fluid flow in microchannels

KOLESNIKOV, ANTON  
Experimental investigation of hydrocarbons formation and transformation under Earth's upper mantle conditions

KULLAB, ALAA  
Desalination Using Membrane Distillation- Experimental and Numerical Study

MAYORCA JIMENEZ, MARIA ANGELICA  
Numerical Methods for Turbomachinery Aeromechanical Predictions

SIDDIQUE, WASEEM  
Design of Internal Cooling Passages: Investigation of Thermal Performance of Serpentine Passages

UDOMSRI, SEKSAN  
Combined Electricity Production and Thermally Driven Cooling from Municipal Solid Waste

## INDUSTRIAL "MILJÖSKYDD"

GALLI, ESTER  
Frame Analysis in Environmental Conflicts: The case of ethanol production in Brazil

SUN, QIE  
Understanding the Clean Development Mechanism and its dual aims -The case of China's projects

## INDUSTRIAL ECONOMICS AND MANAGEMENT

CREVANI, LUCIA  
Clearing for action: Leadership as a relational phenomenon

HERDENSTAM, ANDERS  
Den arbetande gommen vinprovarens dubbla grepp, från analys till upplevelse

MANKERT, CHARLOTTA  
The Black-Litterman Model Towards its use in practice

SKOGLUND, ANNIKA  
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Photos:

Anneli Nygårds, Håkan Lindgren, Jann Lipka, Henrik Sahlström, Hasse  
Wassaether, Maarit Ströberg, Gareth Loy, Volvo Group, Aaro Desing  
systems, KTH photodatabase, UN Photo/Eskinder Debebe

Production: KTH, School of Industrial Engineering and Management, Deans Office

Graphic design: Henrik Sahlström

Printed: E-print, May 2012, 300 ex.

ISBN: 978-91-7501-325-1

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