



University co-operation



Nils Leffler, Catherine Körbächer

The ultimate goal of university and industry co-operation is to advance the frontiers of knowledge and incorporate that knowledge into new products, processes, and services. With many of the challenges facing modern society, more scientific and technologically driven innovations are needed to provide the tools required to help ensure a better future for all. Today, there are more scientists at work worldwide than in all past ages taken together. These scientists are better informed and more up-to-date than ever, with new ideas and innovations generated at an exponential rate. Fostering collaborative partnerships in scientific research has

emerged as a critical imperative to sustaining this innovation process and to transfer great ideas into great inventions for the good of society.

How to reap the benefits of knowledge and turn them into jobs and prosperity, however, is not just a question of research and research policy. It is about the conditions for enterprise and how to promote contact between researchers, entrepreneurs and enterprises.

With this in mind, we have asked six universities, all of which have some form of cooperation agreement with ABB, to answer a series of questions related to their cooperation with industry.



Imperial College London

Imperial College of Science, Technology and Medicine is an independent constituent part of the University of London.

Imperial College was established in 1907 as a merger of the Royal College of Science, the City and Guilds College and the Royal School of Mines. It has 14 Nobel Laureates to date.

Imperial College aims to deliver world class scholarship, education and research in Science, Engineering and Medicine with specific regard to their application in industry, commerce and healthcare. It promotes this via internal interdisciplinary research and wide external collaboration.

It consistently achieves high world rankings for research and teaching and due to its industry focus continues to raise more income from industry than any other British academic institution.

Carnegie Mellon University, Pittsburgh

Carnegie Mellon was born in 1900 when the industrialist and philanthropist, Andrew Carnegie, donated funds to create Carnegie Technical Schools. The school was later organized into four faculties: the School of Science and Technology, the School of Fine and Applied Arts, the School of Apprentices and Journeymen, and the Margaret Morrison Carnegie School for Women. It was renamed Carnegie Institute of Technology in 1912. In 1967, Carnegie Institute of Technology merged with the Mellon Institute to form Carnegie Mellon University and it is now one of the leading private research universities in America. It has more than 12 Nobel Laureates to its name to date.

Carnegie Mellon's focus is on collaborative research projects that seek solutions to either immediate or long-term global issues that also provide an educational opportunity for students. It has a long history of bringing practical innovations into daily life. The culture at Carnegie Mellon supports the desire to make an impact on the world, and faculty thrive in this environment by exploring creative lines of research and taking informed risks on potential breakthroughs.

Chalmers University of Technology, Sweden

Chalmers was founded in 1829 and is named after its major benefactor, William Chalmers (1748–1811). The university was state-owned from 1836 until 1994 when it became an independent foundation.

Research at Chalmers ranges from mathematics and natural sciences through to engineering, industrial sciences and community development. In addition, there is the Onsala Space Observatory. Chalmers has some twenty scientific centres, many run jointly with University of Gothenburg, as well as six national centres of excellence.

As for the nature of the research programs with industry, Chalmers says a trend can be seen during the last decade that moves away from the more short-term bilateral contracts towards more long term “pre-competitive” multilateral contracts. A good example of this is a program related to sustainable product development that is now in its 10th year.



ETH, Zürich

The Swiss Federal Institute of Technology is a science and technology university with an outstanding research record. Excellent research conditions, state-of-the-art infrastructure and an attractive urban environment have contributed to its excellent national and international reputation. In fact, the ETH has produced more than 30 Nobel Laureates.

Research activities at ETH Zurich range from fundamental aspects through to applications. The overall goal is to perform experiments with industrial partners that lead to results which will answer questions that are of interest to the industrial partner as well as to the researcher at ETH and whether these answers are fundamental or applied.

In 2005, ETH celebrates its 150th anniversary. The opportunity is not just being used to look back over 150 years of changes and achievements. It is, more importantly, being used to look ahead. Researchers will become ambassadors of science, reaching out to the public at large to explain what they are doing – and to inspire the researchers of tomorrow.



RWTH Aachen University

RWTH Aachen was founded in 1870 by the Prussian government to support the local mining and steel industry. It is the largest university of technology in Germany and one of the most renowned technical universities in Europe. To date it has 6 Leibniz Laureates, the highest honour awarded in German research.

The university works very closely with many leading industries and there are all aspects of cooperation agreements in place from basic research to development projects, and long and short-term (consultancy) projects. The majority of industrial projects, however, are based on very specific problems marked out by industry. Partially government funded industrial research usually has its focus on more general topics relevant to industry, laying the foundations for future applications.

The quality of engineering and science research at the RWTH Aachen University was perhaps one of the deciding factors for international research institutions such as Microsoft, Ford, Aixtron, Ericsson or Philips to settle down in the Aachen region.



Tsinghua, Beijing

Tsinghua University was founded in 1911 on the site of “Tsinghua Yuan”, a former imperial garden of the Qing Dynasty. The university has a long history of high academic achievement. This is particularly exemplified by having, in its alumni, two Nobel laureates in Physics, one Nobel laureate in weather, one Nobel laureate in Chemistry and one Wolff prize winner. There are five established national research centers on campus: Optical Memory National Engineering Research Center; National State Engineering Research Center of Clean Coal Combustion; CIMS Engineering Research Center; National Research Center for CAD Supporting Software; Biochip Research Center.

Tsinghua is regarded as one of the foremost Chinese universities. This leading position is reflected in Tsinghua being selected for the three biggest Chinese awards – National Nature Science award, National Invention award, and National Science & Technology Advancement award.

Approximately half of all its research funding comes from the government and the other half from industry. Over 60 joint research laboratories have been established with foreign companies.





In their cooperation with industries, universities use various business models to define the types of relationship they can accommodate. Each type is associated with a financing model, which is becoming increasingly important as a source of income for the universities. However, the priorities of most schools involved with higher learning are clear – education, dissemination of knowledge and industrial cooperation, in that order.

Imperial College London

At Imperial College (IC), four model types are used:

- *The establishment of consortia (or industry clubs)* that provide reality checks, research direction and relevant case studies. Examples include consortia in Process Systems Engineering, Advanced Composites and Non Destructive Evaluation.
- *Government funding.* The UK government is particularly active in promoting joint industry-University research collaborations. Such research is usually applications based.
- *One-to-one relationships and strategic alliances.* In one to one relationships, the research is completely industry funded. Where several projects are involved – perhaps spanning several departments – Strategic Alliances are the preferred model. A “Relationship Manager” is appointed to facilitate and sustain the alliance.
- *Consultancy services and the hiring out of specialist equipment.* A wholly owned spin out company, ICON, is used to handle this rather more commercial form of collaboration.

Carnegie Mellon University

Carnegie Mellon, like Imperial College, *establishes consortia* to address world shaping issues. Two prominent examples include the “Red Team” and “Carnegie Mellon CyLab”. The Red Team is an alliance of individuals and corporations committed to winning DARPA’s grand challenge – a race of autonomous robots over unrehearsed, difficult terrain with the purpose of advancing the state-of-the art in autonomous ground vehicles. The Carnegie Mellon CyLab was developed as an umbrella organization to educate, and to develop next-generation technologies that are secure, trustworthy, and sustainable. It was founded with the support of more than 50 companies, along with federal agencies and foundations.

In what could be termed a *strategic alliance*, Intel has set-up a research center in Carnegie Mellon’s Collaborative Innovation Center. It is one of four labs in the Intel research network designed to enhance and accelerate long-term research. Under this model researchers flow freely between labs, Intel, and the University, conducting joint research projects designed to generate breakthrough results.

ETH, Zürich

ETH places huge importance on *one-to-one relationships and strategic alliances*. Most co-operations relate to a given research project which is sponsored by industry. The industry partner gets the right of first refusal to negotiate a license agreement related to all results arising from such projects. If the projects are bilateral, the sponsoring company may also purchase the potential IP by paying a surcharge in advance. The industrial partner can also sponsor a certain research project or research area without claiming any rights to the results.

RWTH Aachen University

RWTH Aachen has a very close relationship with industry and this is helped by the fact that between 60% and 80% of the professors in the engineering faculties have been hired from industry. Its business model is primarily concerned with:

- *Private industrial funding:* This includes direct bilateral funding by industry and consortia; Strategic alliances, with, for example, industrial partners (mainly global players); Affiliated institutes, eg, research association for power systems and power economics FGH; Foundations, eg, Volkswagen (Foundation) and the Thyssen Krupp (School); Endowment professorship of Ericsson GmbH, Deutsche Postbank AG, Grünenthal GmbH and Philips GmbH.
- *Joint industrial funding under governmental umbrella:* Engineering and industrial association supported research (the German federation of industrial co-operative research association (AiF)); the Fraunhofer-Gesellschaft (FhG) on contract research; Government-supported research (Federal Ministry of Education and BMBF industry); and International collaborations supported by the EU as well as government-supported basic research, eg, the German Research Foundation (DFG).

Chalmers University of Technology

Chalmers exhibits a high degree of flexibility in that once initial contact has been made between the university and industry, each research group can develop their own models to fit the research and collaboration environment in which it operates. A *Market and Development* office acts as the liaison between the two and provides assistance in recommending a suitable cooperation model if requested.

Technology transfer



Perhaps a unique capability developed within Chalmers is its ability to provide professional project management for contract research arrangements as well as expertise in validation and productization beyond what most industrial partners expect from a university.

Tsinghua, Beijing

In its relationship with industry, Tsinghua adopts several business models including:

- *Entrusted* projects refer to company-sponsored projects which only involve researchers from the University. Omron (Japan) and ABB use this model.
- *Joint R&D* projects combine personnel from the sponsoring company and the University. Alcatel (France) employs this model.
- *Foundation*: as an example, P&G has set up a rolling five-year contract financed with a fixed amount per year. It is called the "P&G Research foundation".
- *Joint organization*: As an example, Tsinghua has established The Energy Research and Education Center with BP.

Successful technology transfer from innovations within academia into a seed company structure or joint venture is a process of significant importance. Providing incentives to innovators, entrepreneurs, venture companies and to the university itself is not as easy as it might seem.

All six universities described here own all the Intellectual Property (IP) generated by its academic staff. Through various means, each university ensures its employees are aware of the importance of protecting IP and the necessity of patenting before publishing.

For industrial collaborations, confidentiality and IP ownership are key issues and each university negotiates around these to provide appropriate arrangements to ensure the most effective protection for commercially relevant research.

RWTH Aachen University

The RWTH Aachen has a number of ways of encouraging knowledge transfer:

- *Top down and bottom up*: Top down offers stake holders financial incentives by the so called "Gründerkolleg" to set up a company. With a bottom up approach, spontaneous seed companies are created out of the various institutes.
- *PROvendis*: In January 2002 a service company, PROvendis, was launched in North Rhine-Westphalia. Its objective is to advise inventors from universities in all aspects of IP rights and the commercial exploitation of inventions. To date, 102 patents in various disciplines have been granted.
- *Funding from the German National Science Foundation*: This foundation encourages the transfer of basic research results into industrial

applications by providing additional funding of up to 3 years. In a pre-competitive field, the results of a collaborative research project are available to an industrial partner in advance of an industrial application.

- *Interdisciplinary forums*: These forums exist to encourage discussion, the exchange of information and the creation of new ideas.

Chalmers University of Technology

At Chalmers University, *Chalmers Innovation System (CIS)* is a term used to describe a sophisticated spin-out system, including an incubator (*Chalmers Innovation*), seed-investor (*Chalmers invest*) and a School of Entrepreneurship, functioning both as a pre-incubator and as an advanced master level entrepreneurship training program. Incentives given to everyone, including inventors, entrepreneurs, and other players in the system include stock ownership in the companies. Occasionally royalty-constructions are used.

Academics are increasingly interested in pursuing entrepreneurship including patenting, licensing and new venture creation as ways of transferring their innovations into useful inventions.

Imperial College, London

The commercialisation of Imperial's IP is managed by *Imperial Innovations*, a wholly owned subsidiary of Imperial College. It is widely regarded as a lead practitioner for technology transfer in the UK and it has the resources needed to develop licence opportunities and spin-out companies to facilitate the engagement of academics with the technology transfer process. In addition Imperial Innovations has the necessary resources to help incubate and grow early-stage technology companies emanating from Imperial's research base. This technology transfer process has, to date, delivered a licensing income of more than £9 mil-



lion (US\$ 20 million) and created some 60 spin-out companies.

Educating students as well as consultancy work undertaken by Imperial's academics also contribute to the knowledge transfer process.

ETH, Zürich

The creation of spin-off companies by employees or students of ETH is strongly supported. The majority of these companies are founded based on research results from the university. ETH assists such companies during the initial set-up stages and provides opportunities for them to meet other founders, sponsors and advisors. Moreover, new companies can rent premises and equipment at the university during their start-up period.

The use of ETH results is usually regulated by a license agreement negotiated between ETH and the spin-off company. Since the beginning of 2004, ETH can hold equity in these companies. New Innovations remain the property of the university and inventors are remunerated in cases of commercial success. Contractual agreements reached with third party companies within the framework of cooperative research projects define whether IP ownership resides with ETH, the industrial partner or if there is joint ownership.

Research results must always be published but a delay of up to three months can be granted to provide sufficient time to implement IP protection.

Tsinghua University

In 1995, the "Tsinghua University-Industry Cooperation Committee" was established to promote and strengthen cooperation between the university, and domestic and foreign enterprises. In addition, Tsinghua Holdings Co. Ltd. plays an important role in the industrialization of technologies developed by the university. It also acts as



an incubator for high-tech enterprises located in the Science Park just outside the campus.

Tsinghua rarely signs its patents away. However, income generated from patents developed within a joint project will be shared between the partners.

Carnegie Mellon University

The academic mission of Carnegie Mellon is to create an environment that promotes the free exchange of ideas and facilitates the dissemination of knowledge. This mission requires members of the university to publish research results in a timely manner. But it is acutely aware that the premature publishing of information may adversely affect the patent, copyright, or proprietary interests of sponsor.

As a nonprofit educational institution, it is essential for Carnegie Mellon to retain ownership of its IP to fulfill obligations the university has under federal regulations and to ensure that faculty members are not blocked from continued research in their areas of expertise. Through various licensing options with special provisions to protect a company's proprietary information, the university provides the company with value for their investment without putting the university at odds with federal or tax regulations. Additionally, under Carnegie Mellon's IP policy, faculty have a financial interest in all IP developed at the University. Carnegie Mellon cannot, under the constraints of this policy, enter into agreements without adequate protection for the faculty member's financial interests.

The universities featured in this article are recognized as global leaders with expertise in particular fields. It is this expertise that acts as a magnet for industrial companies as they search for suitable collaboration partners. Many of the universities are working in micro- and nanotechnology but it is perhaps other areas which have contributed to their renowned reputation.

Carnegie Mellon University

Carnegie Mellon is world renowned for its programs in the following areas:

- **Computer science:** The School of Computer Science, the first-ever school of its kind, was founded by Herbert Simon and Allen Newell. Together with IBM, it pioneered the famous "Andrew File System". Michael "Fuzzy" Mauldin developed the revolutionary search engine "Lycos". In addition, Carnegie Mellon faculty and Sony are working with the company's AIBO robots and other initiatives to bring robots to life in the human environment as companions, helpers, and assistants.
- **Engineering:** The College of Engineering, in particular the Department of Electrical and Computer Engineering, is consistently ranked among the best in the world. The General Motors Lab was created in 2000 and is currently researching the next generation of vehicle information technology.
- **Entertainment technology:** Carnegie Mellon's program in entertainment technology is a unique blend of top-rated drama and outstanding computer science expertise. For example, the university's Entertainment Technology Center (ETC) is working together with Microsoft and the New York Fire Department to augment the training of hazardous materials and anti-terrorist teams by using video game methods and technology.
- **Business:** The Tepper School of Business is a leader in its analytical approach to business and cross-campus collaboration.

RWTH Aachen University

RWTH Aachen is perceived as a leading university in the following areas:

- Energy research, power system and engineering processing.
- Information and communication technology.

- Materials science research.
- Mobility and transportation.
- Production technology.

The university also has competencies in: computational engineering science; experimental physics; catalysis/chemical materials; medical technology/bio materials (cell technology); phononics and nano-electronic technologies; and environmental technologies.

Because of these competencies, RWTH is working together with industry to develop, for example, physical models and simulation tools, and long-term studies related to the future power system structure in Germany.

Chalmers University of Technology

- *Automotive Engineering*: Chalmers has expertise in the areas of combustion and catalysis, vehicle electronics and automotive safety, and design and dynamics.
- *Biotechnology*: Chalmers Bioscience Program supports research activities within four key research areas: Bio-imaging; Bio-informatics; Biophysical Chemistry; and Molecular Biotechnology.
- *Sustainable society*: The Alliance for Global Sustainability (AGS) is a unique, international partnership between industry and four of the world's leading science and technology universities. The research teams have acquired new information about critical sustainability issues in the areas of energy and climate, mobility, urban systems, water and agriculture, cleaner technologies and communications.

ETH, Zürich

- *Materials research*: Ongoing research is conducted in this area together with major Swiss and international companies from the following industries: pharmaceuticals; engineering; computer-hardware; energy; materials; specialty chemicals; food; biomedical implants; and diagnostics sectors.
- *Energy research*: Many individual projects and two framework agreements with international companies are ongoing. One of these agreements resulted in the creation of the "Center for Energy Conversion" at ETH in 2001.

- *Molecular and systems biology*: The Zurich-Basel-Plant Science Center focuses on molecular and systems biology. It also offers an integrative approach towards complex interdisciplinary research projects which lead to diverse partner programs with industry, including multiple-year funding for competitively selected leading edge research projects.

Imperial College London

- *Aerospace industry (military and civil)*: IC is noted for its expertise in information processing and management; systems research; aeronautics; structures and materials. Partners include the UK Ministry of Defence (MoD), the US Department of Defence (DoD), BAE SYSTEMS, Rolls-Royce, General Dynamics UK, QinetiQ and AWE
- *Biomedical research*: Engineers are developing new imaging methods and all-electronic multimedia system to house patient records. They are also designing medical devices such as biosensors.
- *Energy research*: Researchers working in this discipline collaborate with many companies, for example, with Shell in exploration, production and processing. Sustainable energy is also a key theme. IC hosts the recently created UK Energy Research Center which has the objective of drawing together energy research in the UK.

Tsinghua University

Tsinghua plays a very important role in the Chinese ambition of technology innovation. Over the past number of years, the university has been working hard to engage itself in international R&D collaborations with leading companies and leverage its limited resources to conduct leading-edge R&D.

In doing this, the university has earned a reputation for excellence in:

- *IT focused solutions* within the Chinese framework.
- *Life sciences*.
- *Energy research* in the areas of generation, transmission and distribution. Tsinghua is working together with ABB on interconnectivity issues related to China's regional networks.
- *Chemical engineering research* is currently of significant interest to China.

Summary

The growing importance of university and industry collaborations is evident from these interviews. Each university, however, emphasizes that no compromises are made when it comes to the quality of education, the desire to expand human knowledge, academic rigueur, and the freedom to publish. These priorities are successfully harmonized with the interest of corporations to form symbiotic arrangements facilitated by the different business models described above.

This issue of ABB Review exemplifies, with in-depth articles, several cooperation projects ongoing between ABB and universities around the globe.

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Nils Leffler, Catherine Körbächer
ABB Review, Switzerland
nils.leffler@ch.abb.com
catherine.koerbaecher@ch.abb.com