Linking ABB to the academic research world

ABB, like many other large companies, has had a long and successful tradition of working with universities. Most cooperations were started by the local research organizations and were generally complementary to ABB research in progress.

At the end of 1998 an initiative was started by Göran Lindahl and Markus Bayegan to work closer with some of the world's leading universities on a strategic level. Five universities were targeted: Cambridge University and Imperial College, both in the UK, and Stanford University, Carnegie-Mellon University and Massachusetts Institute of Technology in the US.

The process began with high-level interaction in which ABB outlined its business strategy and the universities correspondingly explained their leading research interests. In the following months, selected ABB research program managers contacted professors at the universities and worked out specific research proposals. After internal discussion at ABB, some of these proposals were selected as projects, which were then initiated.

In parallel with the creation of the research projects at the universities, master agreements, covering the mode of cooperation and the treatment of intellectual property rights were drafted and have subsequently been signed.

The goal of university cooperation is to set up a network that opens up new technologies of interest to ABB, to shorten development times by combining our research resources with those of a university, and to recruit and train people.

Currently we have 35 projects under way, covering the following topics: materials (7 projects), sensors/micro-engineered mechanical systems (MEMS) (5), robotics (5), controls (5), manufacturing (3), software (4), O&G (3), distributed power (2), communication (1).

Many of these projects address new technologies for ABB, and the work would normally have to compete for funding in the usual way. By cooperating with these universities, we can achieve a fast start, at a very high level of quality, in topics which ABB has declared to be of strategic importance, such as MEMS, new materials, communication, biotechnology, to name but a few.

Other projects are more complementary to our own internal research, eg projects in automation and control.

Very often, universities create consortia or network programs in which we can participate, for example MIT's 'Leaders for Manufac-

turing' program. Here, the most important output are students with an industrial background who spend two years at MIT, six months of which can be spent with a sponsoring company. We are currently making use of this program to accelerate the build-up of our manufacturing technologies capabilities.

This leads to the third reason why we want to cooperate with these universities: systematic recruiting of world-class graduates.

Cooperation with universities is challenging in many ways: ABB tends to demand (short-term) results, while universities like to have the freedom to conduct research in their own time. A university project often involves a learning phase for a student and this can delay a project. Supervision and direct action by the ABB program manager or project leader is essential for the success of a project.

An example of a successful, but long-term project is the MEMS micro relay project in which we are investigating the potential of MEMS technology for low-voltage applications. The miniaturization and batch processing opportunities offered by MEMS are very favorable for a technology platform with high volume production. This is a three-year project and has a special focus on moving mechanisms and heat management.

Future editions of ABB Review will carry detailed reports on the progress of our collaborative projects

Automated baggage loading

ABB Corporate Research helps ABB Airport Technology enter a new, fast-growing market.

Not surprisingly, baggage handling is one of the core processes in airport business, and customer confidence can be directly related to how reliably and professionally the baggage is handled. The main obstacles to automation are the loading and unloading phases, both of which tend to be complex. By redefining the overall baggage process, ABB Airport Technology has solved these problems and taken the technological lead in this core area of airport business. Corporate Research contributed to the development of two new key products that ABB Airport Technology will soon be marketing under the names of Bag-Loader™ and Bag-Offloader™

Using a robotized loading cell with an intelligent analyzing and sorting process implemented in front of it, the Bag-Loader significantly reduces the manual labor involved, and is likely to act as a catalyst for massive new investment in the optimization of this airport process. System reliability is ensured by an integrated laser-scan unit, which verifies successful handling of a load by the robot and makes sure that no bags are damaged.

The Bag-Offloader features a specially developed adjusting and tilting mechanism for easy unloading of containers and ramp-carts. The tons of bags and suitcases that are moved by staff today can be offloaded in the future at the touch of a button.

Interior bell applicator

Reducing the VOCs (volatile organic compounds) emitted during car-body painting is a high-priority program of the global automotive industry. The painting process consumes

huge amounts of paint, and car manufacturers have invested in water-borne or powder paint, rather than solvent-borne paint, for several years in order to reduce VOCs. ABB supplies the industry with a series of high-performance rotating-bell electrostatic atomizers that reduce the amount of paint used in automotive painting of car-body exteriors. Now, a rotating-bell atomizer for interior painting has been developed that will pave the way to a new environmentally friendly painting process for car-body interiors, where to date conventional pneumatic guns with low paint transfer efficiency are employed. A higher paint transfer efficiency and superior surface quality are two of the benefits of the new atomizer.

The robotic adapted atomizer is of compact design for easy movement inside the car body. It offers a wide range of adjustable fan pattern sizes (from 50 to 300 mm), and is generally intended for painting small areas.

Residential Power System for converting DC from fuel cells to usable AC for homes

Numerous publications have been devoting space recently to the vital role that fuel cells will play in the future in supplying electric power and heat to our homes. However, the fuel cell itself is not the beginning and end of the story – the energy that is produced by the fuel cell still has to be made usable for the home.

This is why the ABB Electric systems Technology Institute in Raleigh, North Carolina, is developing a Residential Power System (RPS) that will process the power from a fuel cell to make it suitable for domestic use.

Approximately 500,000 US homes have no connection to the grid, and 300,000 new homes are built annually in locations requiring extension of the grid. Also, many millions of homes are located in areas where, since there are fewer than two homes per square kilometer, maintaining the grid is very expensive. All of these represent early markets for a fuel-cell-powered RPS.

If the RPS cost and efficiency targets are met, the system will also become competitive with the grid in many US cities, thus increasing the market to many more millions of homes.

The market for RPSs powered by fuel cells is expected to grow significantly over the next several years.

ABB business area DDT joined the development effort in 2000 and will ultimately take the RPS to market. The main design challenge is to produce a low-cost power electronics system with very high efficiency at partial loads. To achieve the design goals, both the cost and the partial load efficiency need to be several times better than the figures for existing state-of-the-art technology. Meeting the cost and efficiency targets will expand the market for the RPS into realms where it will be competitive with a conventional centralized power generation and distribution system.

Solutions for condition-based maintenance

ABB is moving into many areas of knowledge and service, and to fuel this fast-growing market it is expanding its software portfolio. One such addition to the portfolio is a unique soft-

R&D

ware, called ARMADA^{CMS} (Advanced Rotating Machines Diagnostic Analysis, Condition Monitoring Software), which can monitor, analyze and report on machine conditions in plants of all types around the world.

The condition monitoring techniques commonly used in predictive maintenance rely on planned inspections or testing of machinery, which in most cases can non-intrusively determine a machine's health. However, one single machine is often maintained by different teams, each counting on a wide variety of tools and techniques. ARMADA^{CMS} will help integrate and automate diagnostic tools and enable the ABB Service structure to diagnose problems in rotating machines.

ARMADA^{CMS} is built much like a database in the new ABB standard, compiling automatic reports as ABB Service employees monitor electric motors to increase efficiency, predict problems and optimize productivity.

ARMADA^{CMS} is the result of intense cooperation between ABB Corporate Research Centers in Poland and Finland, ABB Lenzohm Service India and several ABB Service companies around the world. Corporate Research has been responsible for several key achievements that have resulted in higher-quality measurements and diagnosis than with the methods currently in use.

Unlike the traditional 'expert systems', which usually require a large effort for initial set-up and a learning period (to create their own database history) to be able to respond to machine behavior, ARMADA^{CMS} is designed to simplify the analysis procedures to a single set of measurements integrating measurement templates, vibration and dielectric analysis, and easy reporting. It is a comprehensive solution that, thanks to its modular conception, can continuously grow and improve the existing capabilities. Further development in the future will provide an even more comprehensive range of diagnosis. This can vary from dedicated modules for vibration analysis of other equipment, such as pumps and gearboxes, to fault classification of defects in roller bearings without the need of bearing data.

For Web applications, more complex data exchange and direct access to the machine database can be enabled via a browser. This can provide plant visualization, upload routes to data collectors, a learning network, on-line expert support, etc.

The software is now working its way into plants and factories around the world

Looking to the future, imagine the value of a database of countless machines being repetitively measured according to identical standards, registering behavior and failure modes and enabling comparative data extraction.

By using data mining techniques we can learn much more about the machine life cycle, thus allowing very precise diagnosis of complex problems, as well as being able to preview the remaining lifetime and take preventive action much earlier than is possible with the methods in use today.

The next edition of ABB Review will feature a full-length article on ARMADA^{CMS}.

Centrifugal pump