In 2010, CSEM achieved excellent results in line with its mission, namely the development and transfer of advanced technologies to industry. We obtained many technological successes, while meeting our financial objectives and most of the credit for that must go to our engineers and scientists for their commitment and excellence.

We are pleased to report that in 2010 we conducted more than 150 projects, the majority of which were technology development, integration and transfer contracts with Swiss industry. Furthermore, CSEM contributed to a record volume of projects in 2010 with Switzerland’s Commission for Technology and Innovation (CTI). Thus, CSEM confirmed its significant contribution to Switzerland’s leadership in innovation, the main driver of growth and economic well-being in our country.

Relationships with all groups in the national research landscape were strengthened. New projects were initiated, while existing collaborations were reinforced with ETH domain members, mainly with both of the Federal Institutes of Technology, the Swiss Federal Laboratories for Materials Science and Technologies (EMPA), and the Paul Scherrer Institute (PSI), as well as with the Universities of Applied Sciences (HES). Beyond Switzerland, our collaborations with world-class international research institutions, such as CEA in France, VTT in Finland and the Fraunhofer Group for Microelectronics (FhG) in Germany, in the framework of the Heterogeneous Technology Alliance (HTA) have been extended. This is unique at a European level.

Important market trends affecting society, such as cleantech, clearly require ongoing efforts at CSEM. Recent projects were started for the development of microtechnology-based solutions in the fields of water purification, supervision of zero energy buildings, energy management, and wireless monitoring dedicated to sustainable agriculture. Cleantech and environmental technologies are also key domains of activity with regard to our international collaborations.

We believe that CSEM’s strong know-how in low-power consumption, miniaturized sensors, and monitoring systems, in addition to our expertise in industrialization and technology transfer, enables us to play an important role beyond cleantech, in fields where CSEM has traditionally been successful over the past two decades, namely the watch industry, healthcare and aerospace.

Claude Nicollier
Chairman of the Board

Mario El-Khoury
CEO
MESSAGE

Claude Nicollier, Chairman of the Board

Mario El-Kheury, CEO
Successful capital increase
CSEM raised significant new capital from the watchmaking industry’s fund for research, Fondation en faveur d’un laboratoire de recherches horlogères (FLRH). The new investors were joined in the round by existing shareholders, mainly Swiss companies who also increased their investments and holdings.

ISO quality certification achieved
In order to provide customers with technologies and designs that are industry-ready, the Microsystems technology division achieved ISO9001 certification. This is in addition to the Systems division, which has been certified since 2001. CSEM also has ISO14001 certification, for environmental processes. These quality certifications assure that CSEM’s business and technology processes are professionally certified, which in turn assure our partners of the high industrial quality of CSEM’s R&D work, from the laboratory to the finished product.

CSEM participates in Swiss technology delegation to Brazil
In August, Mario El-Khoury joined a high-ranking delegation of Swiss researchers and politicians, led by Didier Burkhalter, on a visit to Brazil, with the goal of increasing technology transfer collaborations and activities between the two countries. In Brazil, CSEM continues to flourish, with valuable contribution to fields such as sustainable agriculture.

Project makes Swiss Technology Award finals
CSEM received an acknowledgement of its leading role as innovator in medical technologies when the project, completed for research partner SenseCore AG, made the finals in the Swiss Technology Awards. Originally, CSEM developed an unobtrusive monitoring system for the European Space Agency, which wanted to be able to measure astronauts’ vital signs over the long term. Now, extreme sports participants can use the same technology to measure heart-rate, respiration, blood-oxygen levels, and body temperature.
Biannual microtechnology open-house Micro10
In September, CSEM participated in the three-day Micro10 exhibition in Neuchâtel. Its goal was to show to the public the wealth of microtechnology know-how both at CSEM and among its partners, including EPFL, FSRM, HE-ARC, Micronarc, Neode, University of Neuchâtel and CNCI. The theme was “Microtechnology at the service of man”. Earlier in the year, the Haute Ecole Arc Ingénierie and CSEM signed a brand-new research contract aiming to place microtechnology at the service of the watchmaking industry.

Ten years of CSEM in Alpnach
Employing about 40 highly qualified staff in its labs, CSEM Alpnach is specialized in microsystems packaging and lab automation. While Alpnach celebrated its first decade of existence, a new CSEM lab was approved in Canton Basel-Land. Its areas of specialization are thin-film coatings and optical technologies.

Think tank: Swiss semiconductor industry
In November, CSEM Neuchâtel hosted an important event that attracted more than 30 Swiss semiconductor industry professionals. Topics discussed included Switzerland’s technology trends and market opportunities, as well as the country’s strengths and weaknesses, along with concrete ideas about improving education and training, and where to focus chip-sector R&D.

CSEM and EMPA host Functional Materials events
The result of a fruitful collaboration, the two functional materials events were fully booked, attracting 180 individuals from 120 companies. The success of these events shows that Swiss industry is interested in what CSEM and EMPA can deliver. Similar potential is hoped for as a result of a new phase of cooperation with the Paul Scherrer Institute, another Swiss Federal Institute of Technology domain organization to sign a framework contract with CSEM.
As a non-profit RTO (Research and Technology Organization), supported by federal and cantonal authorities as well as private Swiss companies, CSEM’s role is to be of service to Swiss industry and society by developing and offering cutting-edge microtechnologies. A key tool of the strategy is to undertake custom development for industrial clients. The services range from feasibility studies, to custom product development, to small-series production. A second tool is the creation of start-ups, which complement and strengthen the offer of products and services within the existing industrial framework.

A key aspect of our strategy is the strengthening of our capabilities by participating in research consortia. For example, those within the framework of European Commission projects, which target pre-competitive R&D. Our goal is to follow up with European peers, and to continue development in order to create solutions for markets and society, beyond the R&D framework.

What makes CSEM special is its high level of expertise in integration and industrialization. Its technologies are able to address the needs of a very wide range of markets, from healthcare, watches, aerospace, security, and medical, to consumer electronics and cleantech.
CSEM’s ability to optimize value creation is based on several pillars. One pillar is the support of the Swiss federal and cantonal authorities, as well as the Commission for Technology and Innovation (CTI). Two other pillars are the professionalism of our people and our excellent relationships with institutions such as EPFL, ETHZ and the universities of applied sciences, as well as selected European RTOs (such as the CEA, FhG and VTT), in the framework of the Heterogeneous Technology Alliance (HTA). A very important additional pillar is our regional presence in various parts of Switzerland.

Furthermore, we defined common projects to accelerate the results of our cooperation with national and international RTOs, with the aim of exploiting common themes and synergies, while targeting specific needs. For instance, with EMPA we defined a cooperation plan on the topic of smart textiles and ultra-fine mechanics. For the Synchrotron Light Source project at PSI, CSEM is more than proud, under the PSI mandate, to provide mechanisms. With our European partners of the HTA, we established common R&D projects for wind-turbine monitoring and for health management, as well as several direct projects with industrial partners.

Beyond the initiation of a wider and more systematic cooperation, specific projects are underway with EPFL, either as a result of ad hoc cooperation, or as common projects funded within national public-sector initiatives, for example, the Nanotera program, as well as international projects like the European Commission’s framework program, FP7.

And lastly, but also very importantly, we are working to improve the link between our regional centers and local industrial clusters, using a multitude of approaches, for example by organizing events in Basel and Alpnach this year to encourage networking between companies in industry, as well as between industry and CSEM. In parallel, internal processes are being defined to optimize internal cooperation, enabling regional industrial clusters to profit from CSEM as a whole, in addition to services offered by specific, local regional centers.

ETHZ: Eidgenössische Technische Hochschule Zurich
FOUR STEPS...

Creation and development
By analyzing long-term trends in society and markets, CSEM defines technology platforms that are suitable for future target markets. These technologies, which usually begin life as internal research projects, are selected based on their potential use by Swiss industry or the Swiss economy. CSEM in turn develops and maintains the platforms and also typically combines two or three domains; for example, low-power wireless networking, micro-electro-mechanical systems (MEMS), sensors, and photonics. In 2010, the watch industry, cleantech, health and wellness, space and aeronautics, as well as environmental applications, were important targets for CSEM’s know-how.

Integration
CSEM has an established track record of physical integration expertise. It can integrate CMOS circuits and passive devices to create components and/or sub-systems, but it is also able to provide complete solutions by integrating different technologies, such as photonics, wireless communications, microelectronics, mechatronics and MEMS. Furthermore, CSEM’s talent for integration is also leveraged for universities and labs, to integrate off-the-shelf components in new functional prototypes. CSEM is also able to act as a systems integrator in applied research projects.
Industrialization

CSEM can take highly innovative research breakthroughs made at universities and polytechnics, as well as national and international partner RTOs, to a validated and industry-ready state. We are a preferred partner because of our ability to build multiple bridges between scientists, research and industry. In practical terms, CSEM can perform proofs of concept, stabilize technologies, and develop prototypes and products that are designed to be robust and cost-effective, but that can also be manufactured in a foundry or fab.

Technology transfer to industry

CSEM has over two decades of experience in developing novel microtechnologies, including MEMS, wireless, and CMOS design. Its industrial partners can tap into this extensive know-how and experience through technology transfer projects. Today, CSEM is a preferred partner for Swiss industry, with returning customers representing 55 percent of CSEM’s contract research revenues.
Heliotis

POWERFUL PIXEL PROCESSING IN A 3D IMAGE SENSOR

Based in Root, near Lucerne, Heliotis AG was spun off from CSEM in 2005 to commercialize a patented, miniaturized imaging chip which enables affordable 3D imaging in real time. Heliotis is an excellent example of how CSEM successfully transferred technology to the Swiss economy through a spin-off company.

The company’s core technology is a CMOS sensor array whose parallel pixel processing is so powerful and efficient that it captures and processes up to one million 2D images per second. A standard camera captures only 50 such images per second. Depending on the type of light source, the imaging can be either tomographic or high-speed topographic.

Heliotis is developing imaging sensor solutions for companies in its target markets in the medical, diagnostics, dental, cosmetics, photovoltaic, electronics, forensic, consumer, luxury, and pharmaceutical manufacturing sectors. This young company began life with a patent portfolio transferred from CSEM. It also benefited from the transfer of the results of ten years of multi-disciplinary research performed by teams at CSEM, the Institute of Microtechnology (IMT), and EPFL. Originally, the innovation was seen as a cutting-edge 3D microscopy solution, but once industry partners started to understand the functionality and quality of the technology, other applications emerged, such as handheld portable scanners.

Today, Heliotis generates revenue in several ways. First, it has customers that are original equipment manufacturers (OEMs) such as Pyramidal Technologies Ltd and Essemtec AG. These companies sell forensic ballistics equipment and optical inspection systems for electronic circuit board manufacturing, and have signed long-term OEM supply contracts.

Heliotis also has customers that contract it to deliver complete, customized systems. For example, it delivers bespoke quality inspection tools for Swiss luxury goods manufacturing. In addition, Heliotis sells its own branded optical scanning solutions, and also supplies imaging subsystems for use in larger systems. For example, the camera chip is used in a handheld intra-oral scanner. The scanner is targeted at dentists, and has the potential to disrupt the way that false teeth, braces, crowns, and other orthodontic products are made. The scanner replaces a manual and labor-intensive, time-consuming mold imprinting process.

Today, the dentist ships the impression to a lab, where a crown or orthodontic part is made. With the new technology, a dentist scans the patient, and then sends data electronically to a central lab where it is processed. According to Heliotis, if this method completely replaces the existing one, some 150 million imprint casts could be avoided worldwide each year, and 275,000 dentists could be working more efficiently.

By any standards, Heliotis is a successful technology transfer case study. It is profitable since 2008 and has sufficient capital to finance growth and to reach its mid-term business goals. It also provides jobs for highly-qualified engineers in the central region of Switzerland. Heliotis management expects 2011 revenues to be double the previous year’s income. The company continues to collaborate with CSEM via direct research contracts and state-funded projects. For example, an agreement was signed in 2010 to cooperate on the development of an anti-counterfeiting inspection tool. This is a multi-million franc project endorsed by pharmaceutical industry participants, as well as pill manufacturing equipment vendors.
Micrometer resolution topographic map of a chip carrier
CSEM delivers RF front-end and design know-how to industry

When u-blox AG decided to develop the RF front-end for its next generation Global Navigation Satellite Systems (GNSS) receiver chip, instead of sourcing intellectual property (IP) from a US or European IP vendor or design house, the Swiss company turned to CSEM to develop several key components of the RF section and know-how transfer. The project, code-named Jupiter, which was partially funded by the CTI and partially by u-blox, enabled the publicly-traded company to access CSEM’s wireless and RF know-how, as well as to develop the required intellectual property.

The Jupiter project is a good example of technology transfer from CSEM to a Swiss industrial client. The client company currently employs more than 200 people worldwide, of which about 90 work in the Zurich area. u-blox is a fabless semiconductor manufacturer and leading manufacturer of GNSS modules and wireless connectivity modules, which are used in high-volume consumer, industrial and automotive markets worldwide. The design team of the client company wanted to exploit the option of shrinking the geometry of its current CMOS GNSS receiver chip to a 65 nanometer (nm) process, in order to achieve a low-cost-solution targeting high-volume production.

At the time, the smallest geometry used in u-blox’ GNSS chips was 130 nm, while the closest competitors were offering 90 nm GPS chips. Another design challenge faced by u-blox was the
need to reduce power consumption, and it required a reduction of at least 50% compared to the previous generations, leading also to a request to significantly reduce the RF part’s supply voltage. Furthermore, there was a strong desire to reduce the need for external components, and thereby enable a lower-cost system design.

One way that CSEM solved these issues was to use its own passive devices, capacitors, and inductors. According to the Jupiter project manager, almost every project completed in microelectronics has required CSEM’s to use its own device designs. Foundries just do not have these parts in their libraries, and this project was no exception. In addition, CSEM used a frequency divider design of its own to lower the power budget. It was successful and reduced it by an order of magnitude, now consuming one-tenth of the frequency divider in the previous chipset generation.

CSEM was able to satisfy all the requirements specified by u-blox, and on time. It hit the power and noise figure targets, and the RF front-end chip was integrated by u-blox into their GNSS System-on-Chip.

An ongoing challenge for CSEM throughout the project was the transfer of intellectual property and know-how to u-blox. As stated earlier on, the company wanted not only to source design IP for a new chip; it also wanted to have the related RF-design know-how transferred. To address that need, CSEM successfully took a co-design approach, using shared databases and shared design tasks on the RF blocks. CSEM also provided test benches, feedback and information, as well as simulation setups, reports and documentation to the u-blox team. From CSEM’s point of view, one of the reasons this project had such good results was that its customer was very clear on its needs and requirements.
No Hands: Precise and automated cell selecting, sorting, and packaging

In biological labs around the world, technicians painstakingly select, sort, process, and package thousands of healthy animal cells so that pharmaceutical companies can develop new drugs. Cell handling is a tedious process that demands the kind of concentration and manual dexterity required of a Swiss watchmaker. It is an industrial problem that CSEM – with its expertise in highly-precise microrobotics systems and machine-vision enabled automation – was perfectly suited to address, and it did so in a European-funded framework project called Hydromel.

The four-year 14 million Euro project, which ended in September 2010, is a good example of how CSEM can play an important role in international research projects. It had the role of project leader, with financial, technical, and administrative responsibility, while Hydromel involved a total of 24 partners from academia and business. Of the five demonstrators elaborated in Hydromel, the automated cell handling system, described here in more detail, created the biggest interest.

The first end-user is the French biological materials supplier Biopredic International. It is testing the tool to sort, select, and re-package cells and biological materials. These are used in drug discovery labs for drug testing, as well as in better understanding cellular systems. Researchers often use fish and amphibian cells to avoid animal and mammal testing.

The cells must be healthy ones that have not been damaged during the selecting and sorting process. That is why the sorting and processing is typically done by hand. But now CSEM and Hydromel can offer an alternative that consists of a tabletop system that performs cell sorting, injection, and collection. Several hurdles had to be overcome by the project team. For one thing, the automated system had to be able to handle the cells without crushing them or destroying them. So the designers decided to transport the cells in a suspension from station to station, using microfluidic systems know-how.

The suspension is agitated at the beginning so that the cells don’t stick together. The suspension travels through the system and is pumped into a machine-vision module that differentiates healthy cells and non-healthy ones. This requires a sophisticated self-learning algorithm, as well as sensors to verify that the sorting process is functioning without error.

Next, the system automatically selects individual cells from the suspension, transports them to the injection module, and finally drops the cells into a glass beaker for transportation.

Besides the technical challenges, this project had a couple of psychological ones too. The end-user needed to be convinced that the robotic system could do as good a job as a human. The equipment also had to be shown to be reliable, with no breakdowns, and it had to be easy to use. As one of the researchers involved in the project puts it, if more than three buttons are needed to operate the equipment, the design would be considered a failure.

With the project successfully completed in 2010, interest has been expressed by several labs from around the world, and prototypes of some of the modules are already in use with industrial partners. The CSEM team in Alpnach is now preparing to begin the next phase of the commercialization process.
Sorter module for vision-based selection of healthy cells
Tiny CSEM encoder breaks speed and resolution records

With 20 years of encoder development, it’s not surprising that CSEM has broken a new performance record, this time with an optical encoder that it calls Xcoder. Measuring just 4 mm across its code-disc diameter, it is the fastest, most precise, and most versatile miniaturized encoder created to-date, according to the researchers.

The tiny encoder was developed in a project funded by the CTI Discovery program. It is a good example of an internal and early-stage research project that has high potential for several Swiss companies. Optical encoders are crucial components in motion-control applications. Typically, installed right next to a motor, the encoder measures things like speed or motor shaft position, and then delivers the information to a motor control unit.

Xcoder has a 20-bit resolution and can track one million turns per minute. It is ten times smaller, 100 times faster – and offers a higher resolution – than any other encoder. In other words, you might find an encoder that is similar in size, but it will only provide a fraction of the resolution. And you might find one that achieves 20-bit resolution, but it would be ten times the size of Xcoder.

The fast rotation speed (greater than 1,000,000 rpm) means that Xcoder should be compatible with future applications, according to its designers. Although such industry requirements do not even exist yet, it is likely that super-high-speed electronic motors that have a small form factor will eventually emerge. The fastest electronic drive demonstration to date spins at one million rotations per minute. The record was achieved about a year ago by the Zurich-based startup company Celeroton, a spin-off of the Federal Technical University in Zurich (ETHZ). Such high-speed drives are likely to be used in medical and dental tools, as well as micro-machining tools.

A key feature of Xcoder is that it’s designed with manufacturability in mind, due in no small part to the contributions of the Swiss industrial partners involved in the project. It is also a very low-cost component when produced in large volumes. After completing a detailed concept for the design and integration, CSEM researchers developed the ASIC encoder, as well
as an LED-based optical module, and the photonics subsystem to embed it. Other project partners included a CSEM photonics team in Zurich and a microelectronics team in Neuchâtel.

The encoder has been tested and demonstrated in the lab and is now at the proof-of-concept phase. The first application is to use it in very small motors and small machines, down to 6 mm diameter. Other applications that are being considered are robotics, 3D scanners, measurement tools, and larger electrical motors. Building on the success of these initial developments, CSEM is currently applying for the funding to execute the next phase.

The aSIC encoder fits in a 6 mm diameter motor.
The corporate culture at CSEM can best be summed up in three words: consideration, respect, and continuity. The first two are evident in the way we manage human resources and accept our social responsibility, while the third is shown in our low staff turnover rate. The idea behind continuity is to attract the best talent, and then keep it, since CSEM’s primary asset is the knowledge and experience of our people.

The ways that CSEM keeps staff in the long term are as innovative as the technologies the company develops. It offered in-house day care long before other organizations had even entertained the idea. CSEM also established a detailed employee charter, which is published in three languages on its website. Its terms of employment are also flexible. For example, CSEM offers part-time jobs, the ability...
to work from home, and continuous education funding to develop job skills. National recognition of CSEM’s socially responsible efforts came most recently when Anne-Marie Van Rampaey, Vice-President Human Resources, was appointed president of the jury of the Prix Pride, a cantonal award for sustainability.

Currently, CSEM employs 390 people, all sites included. The number of employees has remained stable for the past few years, despite the worldwide financial crisis that began in 2008. Furthermore, we are identifying more and more engineers from industry willing to pursue their career in the field of technology development, integration and transfer, which is the essence of CSEM: these engineers very naturally are hired by CSEM and are now the majority of our personnel. Today, some 65% of staff comes from industry, while 35% come from academia. An ongoing trend is to recruit the best and brightest regardless of nationality; as a result, 35% of staff is international. There are 40 people doing PhD research at CSEM, and several employees teach graduate and undergraduate courses part of the time.

Last but not least, CSEM has a relatively high percentage of women in the workforce, some 25% overall and about 13% in the technical departments. In recognition of CSEM’s gender promotion, the company was featured by the State Secretariat for Economic Affairs (SECO) as a role model for industry. This puts CSEM in the same league as some large-sized companies, and it is one of only two organizations selected from the French-speaking part of Switzerland.

CSEM IN FIGURES

- Engineers in electronics, electrotechnics, electricity: 95
- Engineers in physics, physicists: 60
- Engineers in microtechnology: 38
- Chemists: 23
- Engineers in computer science: 4
- Engineers in material science: 8
- Engineers in mechanics: 8
- Engineers in other domains: 12
CSEM ended 2010 with positive net results. Income was slightly down compared to the previous year (–2%) due to a decision to postpone until 2013 an important project, financed by a partner canton.

Income generated by European Commission projects grew by 12%, despite the weakness of the Euro. Public-sector projects supported by the Confederation grew by 15%, which was below the forecast. However, this was the result of the phasing-out of federal economic stimulus programs to support the economy.

The economic upturn has not yet had a positive influence on our income from industry (–2%). This is because the R&D investment cycle, which is where CSEM projects typically figure, is always slightly behind industry’s top line revenue growth, but we are very satisfied with the large increase (67%) in income from our small-series production activities, in a very specialized niche market.

Thanks to effective cost management, the financial results show a profit in line with our forecast. The overall financial situation was, moreover, improved by an increase in capital that took place in March 2010, and which has enabled us to double our cash reserves and to increase our shareholder equity, which has now reached almost 50% of the overall balance.

### STRUCTURE

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<th>Non-consolidated participations</th>
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## Finance

### Key Figures
Non-consolidated figures

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ORGANIZATION

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Hans Zimmermann Ascom Holding

Auditors

PricewaterhouseCoopers SA, Neuchâtel

“CSEM: INNOVATION, CREATIVITY AND TALENT SERVING THE PUBLIC AND INDUSTRY IN THE FIELDS OF ELECTRONICS AND MICROTECHNOLOGIES FOR RESEARCH AND NUMEROUS APPLICATIONS. IF YOU NEED HELP AND SUPPORT IN THESE DISCIPLINES, ASK CSEM - WE ALWAYS HAVE A SOLUTION!”

Claude Nicollier
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