

Medtech: Potential for innovation

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Summary

Switzerland, with its ETHZ and EPFL, universities, advanced technical colleges, the CSEM, the Empa and the Paul Scherrer Institute, possesses a complete chain of knowledge and interdisciplinary competence which ranks it among the worldwide leaders in medical technology. To ensure that a wider range of excellent research re-

sults are translated into marketable products and methods, the CTI Agency for the Promotion of Innovation launched the Medtech initiative, a success story.

Key words: medical technology; CTI; innovation

A nerve centre for research and industry

Medical technology “made in Switzerland” notches up an annual turnover of 11 billion US dollars and creates 11 000 jobs countrywide. In Europe only Germany and Great Britain boast more workers in this sector. The opportunities for future development are enormous, with growth rates around 7–10%. The research institutes’ high quality attracts major industrial concerns from all over the world: names such as Johnson & Johnson, Medtronic, Biotronik and Zimmer often pitch their tents close to universities. They draw on the highly trained specialist workers for cooperation in developing hi-tech products with high value added, thus providing a stimulus for Switzerland, a research and production hub.

But academics and the industrial community often speak different languages, and business managers feel certain inhibitions about approaching research institutions. To boost knowledge transfer between laboratories and the medico-technological industry, in 1998 the CTI Agency for the Promotion of Innovation launched the Medtech initiative. As part of the life sciences field, it forms, with biology, biochemistry, biotechnology, pharmacology and nutrition, a

logical addition to the medical technology domain. In this context Medtech finances collaboration between research institutions and private industry, within the framework of clearly defined projects which teams of experts scrutinise for their innovative content and market potential. In addition, it offers professional coaching by specialists from the fields of technology, marketing and finance. The coaching embraces all project stages: choice of partner, setting up of the project, project leadership. The project partners choose their own field for development, the participant industrial firm meets 50% of the project costs and thus guarantees its commitment to turning the project into a marketable product. Federal funds are dedicated exclusively to payment of the researchers’ salaries. Medtech’s clients include large and small firms. However, aid is channelled especially towards small undertakings, startups and spinoffs, many of which operate with smart ideas in niche markets. Small and medium-sized undertakings, of which many in Switzerland are active in the medtech field, may face problems due to limited resources.

Trend-spotting

The past ten years of targeted promotion have been a success. From the launching of the initiative to 2008 the CTI Agency for Promotion of Innovation received 355 applications for financial assistance and accepted 185, with a total investment (CTI and industry partners) of CHF

176 000 000. These included a total of over 300 medtech firms and more than 150 research laboratories. The majority of developments were concerned with diagnosis and orthopaedics, followed by work on the central nervous system, cardiovascular problems and surgical equipment and meth-

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ods. This choice of themes reflects our strengths in this domain, but also shows that certain markets are either not or not sufficiently exploited. The competences of the Swiss medtech scene undoubtedly include implants (dental, skeleton), endoscopic methods, drug delivery systems, dialysis and hearing aids, as well as telemedicine and medical informatics.

If Switzerland wishes to further expand its strong position in the medical technology field, it must position itself in regard to current trends. Medical care, in fact the entire health system, has undergone fundamental changes in recent decades. Let us take femoral management as an illustration. In 1950 this meant a hospital stay of some 120 days, over 60% unfitness for work, and a return to work after more than 160 days. 50 years later the picture is different. In August 2001 the skiing champion Hermann Meier sustained severe injuries in a motorcycle crash, involving, among other things, a broken leg. Shortly before the start of the 2003 World Championships in St.

Moritz he was already back in competition, and crowned his comeback in winter 2003/2004 with the overall World Cup title.

If we look at the road we are travelling, we witness a trend away from a medicine of replacement towards one of repair. We need a medicine that is tailored to the individual and takes demographic changes in the western world into account, but which is affordable given the cost explosion in the healthcare system. This means developing smart systems for safe and simple delivery of medication, devising better imaging methods, and creating the basis for economical individual medicine via surgical methods and materials as well as refined surface therapies. The motto is: prevent diseases, enhance quality of life, increase the market penetration of medical equipment. A classic example of development adapted to needs are insulin pumps, which in a mere five years have shrunk from handsize to midget devices.



Figure 1

Excellent results due to close cooperation between academy and private industry, exemplified here by researchers Christelle Volorio of LDCS laboratory (left) and Astrid Cachemaille of Debiotech. (Photo Elsbeth Heinzelmänn)

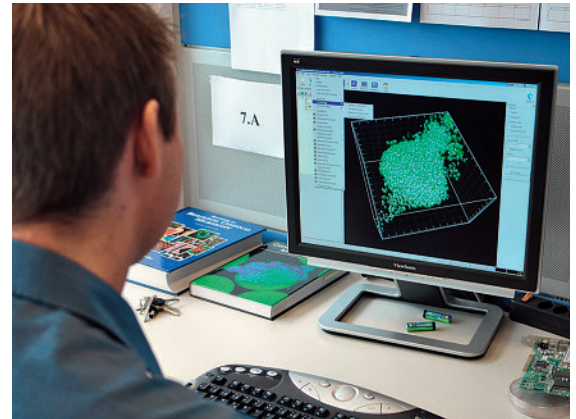


Figure 2

Scientist Nicolas Fête is specialist for computer modelling at the LDCS laboratory, EPF Lausanne. (Photo Elsbeth Heinzelmänn)

Innovation showcase

The precondition for ensuring that the best brains from academe and private industry work on these new trends is dialogue between the partners.

For this reason the CTI Agency for Promotion of Innovation stages an annual Medtech Event in Berne, at which researchers and representatives of business and industry meet to exchange ideas and experience. Some 400 participants gather to take part in a presentation of the year's four most innovative medtech projects. At the end of the presentation the assembly participants choose from among the four candidates the development they consider to have the brightest future, which receives a "Medtech Award" endowed, among others, with CHF 10 000.

In 2006 the laurels crowned the Hünenberg firm Odlo, supplier of sportswear "with method" for applications such as running, cycling and skiing. In a Medtech project shared with Empa, the

Figure 3

At the CTI Medtech Award held annually a jury selects four themes among the most innovative projects which are nominated for the Award. The audience nominated the winner Debiotech/EPFL direct at the 2008 event. (Photo Elsbeth Heinzelmänn)



Interstate Technological University Buchs NTB and the textile firm Bischoff from St. Gallen, Odlo developed a T-shirt made out of conductive fibres. The close-fitting sportswear item incorporates integrated electrodes which record the wearer's cardiac arrhythmias – an unmistakable sign of heart problems – under both physical exercise and in the resting state. The embroidery technique invented by Bischoff Textil Company

ensures a larger contact surface and optimum electrical connection with the skin. The ECG is recorded by electrodes sown into the T-shirt, which transmit the data by radio signal to a recording device worn by the athlete. Thus, for the first time, a problem-free ECG recording over an extended period of time is possible for the patient without falsification of the result by factors such as sweating or body movement.

Top performances in front of a critical audience

Winner of the 2007 Medtech Award was a sophisticated inner ear hearing aid. DACS (Direct Acoustical Cochlear Stimulation) helps patients with disorders of sound transmission and sensitivity. The cause is usually otosclerosis, ossification of the middle ear preventing transmission of sound waves to the inner ear. Previous systems failed to provide satisfactory improvement of hearing for these patients. In a Medtech project Professor Rudolf Häusler from Inselspital Bern, in collaboration with Phonak AG from Stäfa and Cochlear AG from Basel, developed a new-type

hearing implant which generates direct acoustic stimulation of the middle ear. In cooperation with engineers, ear surgeons and audiologists, a system was devised which consists of a surgically fitted implant and an externally worn audio processor. The latter is composed of a microphone, a signal processing unit, an amplifier and a battery. The microphone receives the sound and the electrical signal is then computed and transmitted to the implant via a skin plug. After in-depth testing with anatomical head specimens, the first surgical implantations were performed. Patients with the severest degree of combined hearing impairment, who before had had no benefit from conventional hearing aids, attained an astonishing and measurable auditory improvement.

The winner of Medtech Award 2008 put an end to the widespread fear of injections which especially affects small children. The Debiotech company in Lausanne secured the rights to a Swedish scientist's invention combining, for transdermal drug delivery, microfluid actors with hollow microneedles. In a team effort between Professor Yann Barrandon, dermatologist and skin stem cell specialist at the Laboratoire de Dynamique des Cellules Souches (LDCS), a common chair of the EPFL, Lausanne University and CHUV, the Vaud cantonal hospital, the Lausanne company started a Medtech project. On the basis of a MEMS (Micro-Electro-Mechanical System) the partners produced infusion needles as fine as a hair and only 5 mm in length. These can be repli-

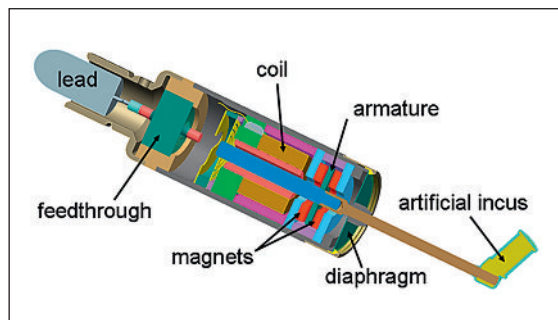


Figure 4

Cross-section of patented DACS Actuator (Direct Acoustical Cochlear Stimulation), developed at Inselspital Bern by Professor Rudolf Häusler and his group. (Photo Inselspital Bern)

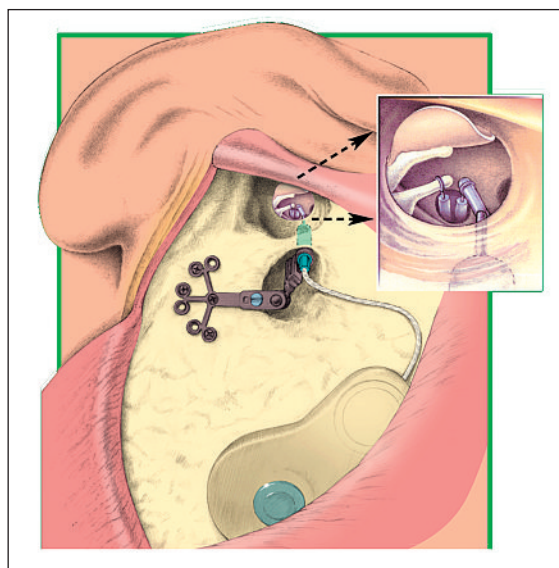


Figure 5

Implantations overview of the DACS system. (Photo Inselspital Bern)



Figure 6

DACS patient fitted with audioprocessor. (Photo Inselspital Bern)

cated in an industrial batch process with high precision and at low cost. An array of 25 microneedles on a chip is fastened to a plastic adaptor for easy manipulation. Thanks to the lateral depressions the physician can target active substances into the skin without injuring it, while controlling injection depth and the injected volume in real time. In vitro tests on pigs' skin and in vivo tests on rats are showing excellent results.

Figure 7

The microneedles manufactured with MEMS precision are notable for extreme sharpness, side openings and controlled length. They are thus robust and skin-friendly, do not injure the skin when inserted, cause no pain, and are also highly accurate and biocompatible. (Photo Debiotech)



The microneedles could be used for desensitisation in allergies, for insulin and hormone administration and for treatment of skin tumours with photosensitive molecules. Experiments have shown that with some vaccines the microneedles achieve a far more efficient immune response than conventional injection methods. Since the microneedles use smaller volumes of costly vaccine and can even be used by untrained personnel, this looks like a major cost-saving development.



Figure 8

Array of microneedles for painless drug delivery is especially suitable for vaccines, since the dose is reduced and the immune response enhanced. (Photo Debiotech)

Challenge of the future

Whither medical technology? Should the worldwide economic crisis prompt fears for our strong position on the global market? There is plenty of evidence that firms in the medtech branch are far less exposed to economic ups and downs than other manufacturing industries. So continued strong growth can be expected, provided of course that certain prerequisites are met. These primarily include strong product innovation, the key to market success and the guarantee of future competitiveness. A factor that will make itself felt in a negative way is pressure on costs, forcing industrial firms to cut costs, with knock-on effects for suppliers. Stronger pressure is also to be expected from the worldwide regulators, who will impose new requirements for approval of medtech products. Those firms will notch up successes which are closely networked with centres of knowledge in their own and other countries, and which, thanks to efficient innovation management, recognise future trends early and respond to them. They include investment in research and

development, as well education and training of the workforce. Essential aspects are integration of key technologies such as micro- and nanotechnology, active substance and surface technology, electronics, robotics and information technology. Cooperation with research institutions for translation of the newest knowledge into marketable products and methods continues to be top priority. The Medtech initiative of CTI Agency for Promotion of Innovation offers a speedy and efficient helping hand to firms and universities.

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