Innovation driven by pioneering scientists

Researchers who venture into the unknown out of sheer curiosity provide the basis for our knowledge society. However, the benefits of this basic research are often invisible or only become apparent much later. Three examples of SNSF projects show how impactful and tangible they can be.

The SNSF invests hundreds of millions of francs per year in basic research. This entails experiments and investigations that are driven by curiosity and for which no immediate social purpose can be planned – but which are nevertheless of inestimable value. Angelika Kalt, Director of the SNSF: "Researchers who are able to pursue their thirst for knowledge are constantly breaking new ground. They provide the basis for innovation and new technologies – and hence for our knowledge society."
Some findings only have an impact after many years. Others lead quickly and directly to concrete applications. "But they always start off the same way: with an intelligent question and dedicated researchers who try to answer it," says Angelika Kalt.

From a trick of the senses to a treatment

An impressive example of this is the SNSF project of neurologist Olaf Blanke at EPF Lausanne. Based on his work on out-of-body experiences, from 2005 onwards he investigated which sensory signals control the perception of one's own body. In order to discover the brain regions involved, Blanke and his team created a novel experimental set-up: they showed test subjects on a device attached to their heads a projection of their own body, thus creating a conflict between the place where one sees oneself and the place where one feels. It turned out that the test subjects experienced the virtual body and its position in space as their own. Tej Tadi, who worked as an electrical engineer for the project, immediately saw the medical possibilities. "The deception activated certain regions of the brain," he explains. "So we were able to trigger real responses through virtual reality." This insight inspired Tej Tadi to found the company MindMaze. It developed a virtual reality-based technology for the neuromotor rehabilitation of stroke and accident patients. In 2017, the US Food and Drug Administration (FDA) approved the technology; since then, it has been used in hospitals in several countries, including Switzerland. And it gave MindMaze a market value of over 1 billion francs.
The company currently has offices in Lausanne, Zurich and San Francisco. It is working on new man-machine interfaces which are expected to transform medicine as well as the computer games and transport industries. "A lot of work has gone into MindMaze's success," Tej Tadi says, "but it all started because we approached a fundamental scientific question from an unusual angle."

Different question – new possibilities

Veronika Brandstätter, professor of psychology at the University of Zurich, also broke new ground with her SNSF project. While motivational psychology concentrated for a long time on what supports people in pursuing their goals, Veronika Brandstätter asked: "What happens when people start to let go of goals they had once set?" She investigated this process using a combination of laboratory experiments and field studies. Her team then observed people who had doubts about a goal – for example, a degree.

"It all started because we approached a fundamental scientific question from an unusual angle."

Tej Tadi, electrical engineer and neuroscientist, founder and CEO of MindMaze

“The results were so clear, they set me thinking about a practical application.”
Veronika Brandstätter, psychologist, University of Zurich

They compared their thoughts with those of people with the same goal for whom everything was going as planned. “We found out that, once their doubts reach a certain level, people become very much concerned with cost-benefit considerations – and are then no longer in a frame of mind that is conducive to action,” says Veronika Brandstätter. This pattern was confirmed, for example, in a survey of marathon runners who described how they make up their minds on whether to give up or continue over the last ten kilometres. It was also shown that doubts have an adverse effect on performance in the long term.

“So clear were the results, they set me thinking about a practical application,” says Veronika Brandstätter. “Often it actually makes sense to give up a goal – particularly when one realises that it is practically unattainable.” Brandstätter’s work has meanwhile become an integral part of the Zurich resource model of Krause and Storch, one of the most successful self-management methods there is. It is used in teacher training, coaching for managers and youth work, among other fields.

Chasing a breakthrough

The work of Michael Grätzel, professor of physical chemistry at EPF Lausanne and an SNSF grant holder, is also seen as highly influential. Towards the end of the seventies, he investigated how light energy can be converted into electrical energy. In the early nineties, the Grätzel cell was developed after years of basic research: a solar cell that uses natural dyes for energy generation, following the model of plant photosynthesis. This principle offers great advantages over conventional silicon solar cells: the manufacturing costs are lower and the materials used are more environmentally friendly. However, Grätzel cells are still less effective in full sunlight – they work better in hazy conditions or with artificial light sources. Yet a market has emerged for them, not least because of their aesthetic appeal.

“The real revolution in the solar sector has not yet taken place,” says Grätzel, “but the dye solar cell has fuelled a whole research field. A lot will happen on the application side in the next few years.” Grätzel’s work became the starting point for the current development boom in solar energy, which is based on the principle of the Grätzel cell. In the meantime, however, light is no longer captured through dyes, but by means of the organic-inorganic semiconductors known as perovskites. Their effectiveness in laboratory conditions is already on a par with that of silicon cells. And at the forefront of developments we again find Michael Grätzel. “That’s how it goes sometimes in research,” he laughs, “thirty years ago, I worked on the basics without any pressure, today I am chasing the big breakthrough simultaneously with thousands of others.”

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Michael Grätzel, chemist, EPF Lausanne

Snow research, for example here on the Weissfluhjoch in Davos, relies on precipitation, wind, temperature and radiation measurements. Hendrik Huwald and Franziska Gerber, both members of Michael Lehning's team, examine the snow cover with a laser scanner (below left). Snow samples are also an important data source. They are CT-scanned and the structure is then replicated using a 3D printer (bottom left).

→ From snow to ice

"One of the unknowns in climate research concerns changes in the polar ice. In our project, we are analysing the impact of the snow cover on the sea ice and ice sheets in the Antarctic region. The measurement data comes from our international research partners, and we also collect some data ourselves. Based on the analyses, we can generate snow accumulation and ice formation models. Eventually, this should make it possible to calculate the overall ice mass also for the future."

Michael Lehning, snow researcher, EPF Lausanne and Institute for Forest, Snow and Landscape Research (WSL)

→ p3.snf.ch/project-160667


RedFox

Study of three Swiss towns: many new flats are being built in Bulle, Canton of Fribourg. Businesses mainly provide for regional needs, the majority of people in work are commuters. Belp in the Canton of Bern is a typical small town with an industry sector that is mostly low-tech (below at left). Thun, on the other hand, is home to a number of high-tech enterprises. Susanne Szenkuti, Michael Gassner and Florian Kühne from Thun's planning office are making use of results obtained in Heike Mayer's research project (below at right).

→ Size isn't everything

"Small and medium-sized towns are often seen as the poor relations of metropolitan areas. However, since 2001, towns in the EU15 countries have been experiencing stronger economic growth than big cities. In Switzerland, too, the economic and political importance of small and medium-sized towns is likely to increase further. We are studying the roles, particularities and potentials of such towns. The results will provide a basis for future funding and development."

Heike Mayer, economic geographer, University of Bern

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