A Small Country with Big Ideas: Science, Innovation and Skills as Drivers of Switzerland's Economic Success

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Speech by Ambassador Markus Leitner, Ambassador of Switzerland to the United Kingdom

American director, actor and screenwriter Orson Welles got it wrong. In *The Third Man*, **Orson Welles**' character Harry Lime says, *"In Italy for thirty years under the Borgias, they had warfare, terror, murder, and bloodshed, but they produced Michelangelo, Leonardo da Vinci, and the Renaissance. In Switzerland, they had brotherly love, they had five hundred years of democracy and peace, and what did that produce? The cuckoo clock."*

Now, we all know that the cuckoo clock is a Bavarian invention and most of these clocks that British tourists buy in Switzerland are produced somewhere in the German Schwarzwald.

Last month, both the European Innovation Scoreboard and the World Intellectual Property Organization (WIPO) named Switzerland as the most innovative economy in the world (with the UK in 4th position). That is nothing new. This was Switzerland's 12th consecutive year at the top of the Global Innovation Index.

The reason behind this?

- Switzerland has been spending well in excess of 3% of its GDP on R&D for many years. It is currently at **3.15%**, which is about twice the investment of the UK.
- Importantly, more than 68% of R&D investments come from the private sector which is of course the driver of innovation.
- Switzerland is also **patent world champion** with the highest number of patents per capita in the world.

A key element of Switzerland's science and research landscape is the 19 public universities (17 are owned by Cantons, ETH Zurich and EPF Lausanne by the Swiss Confederation). Their infrastructure, core facilities and support structures are financed through **long-term public funding**. This is complemented by **programme and project funding** from our research council or innovation agency.

This funding is of course **competitive** but has a **high success** rate (around 30% for projects) because the system is designed to make it easy to get a substantial grant on a given topic but difficult to accumulate multiple grants. A commercial impact of the research is welcome and supported, but the driver for funding basic research remains the accumulation of knowledge.

We still feel that higher education is a public good and should be merit-based. Students are paying extremely low fees, even at the most famous universities.

This is an additional element to attract international talents: Swiss universities have one of the **highest proportions of international students** and more than 50% of our researchers are from abroad. ETH Zurich and EPF Lausanne are in fact in the top five of the most international universities in the world.

With a high proportion of international publications[1] and a high scientific productivity and science quality, **Swiss universities consistently rank highly in international university rankings**. ETH Zurich is considered the best university in continental Europe, and ETH Zurich and EPF Lausanne are the only continental universities that make it into the world top twenty of the QS ranking.

Or to put it differently, **of the 10 top European universities nine are either in the UK or in Switzerland**.

Innovation

So far, I have tried to make the point that we are good at "**turning money into knowledge**". But innovation is actually the opposite, it is about "**turning knowledge into money**". For business to turn innovation into commercial success at every stage of the value chain, a number of elements must be in place. Let's have a look at them:

Orson Welles' punchy line reminds me of a publicity video by Switzerland Tourism last year. In this short clip, Swiss tennis legend Roger Federer tries to convince Robert de Niro to come to Switzerland and to join him for a series of activities in the spectacular Swiss landscape. Robert de Niro steadfastly refuses to follow suit and explains to a surprised Federer: "There is no drama in Switzerland! No drama at all!"

Investors, researcher and inventors might be driven by out-of-the box thinking, disruptive approaches and a particular risk appetite. But with all the uncertainty that goes with investing money into researching, developing and launching new technologies, products and services, you might not be looking for additional chaos and drama, but rather for a **stable, business-friendly economic environment**.

The Swiss government therefore focuses on transparent laws and regulations, a well-run education system, low taxes, world-class research institutions, high-quality infrastructure, protection of intellectual property, sound public finance, international market access etc. We are **not directing or funding innovation strategies**. In fact, we don't have an industrial or an innovation strategy that highlights particular fields.

At the same time, with a current account surplus, high salaries, an open market economy and a continuously strengthening Swiss franc, **Swiss companies are under a constant pressure to maintain their international competitiveness**. Such framework conditions keep companies on their toes, because to grow productivity, innovation is key.

[1] 2nd in the world for the number of publications per million inhabitants (behind Denmark)
3rd in the world for overall publication impact - which is a proxy indicator for quality (behind the Netherlands and the UK)

Who built the **first phonograph** in 1877? (hint: if a Swiss Ambassador asks you such a question, your answer should start with: “a Swiss”.)

Johann Heinrich Krüsi (John Kruesi) was born out of wedlock in 1843 in Heiden, in the rural Eastern part of Switzerland. He spent his childhood in an orphanage, had to work early as a weaver and obtained only a basic education. Nevertheless, fascinated by machines, he managed to complete an apprenticeship as a locksmith, followed courses in mathematics and technical drawing and eventually became a mechanic. He gained more experience by working in various industries across Europe before emigrating to the United States.

In 1872, John Kruesi met Thomas Alva Edison and started to work at his Lab in New Jersey. Edison quickly noticed the mechanical talent of Kruesi and promoted him to chief machinist. On 12 August 1877 Kruesi found a rough drawing on his workbench on which Edison had written, "Kruesi, make this." When Kruesi asked what the machine was supposed to do, Edison answered that the machine needed to be able to talk.

And based on the rough sketch, Kruesi experimented for two days and finally built the first phonograph. In a very similar way, he built the first Edison light bulb and many other inventions by Thomas Edison and by himself.

What do I want to tell you with the fascinating story of John Kruesi? As important as a genius inventor and researcher is, just as important are the people who can translate these ideas into technologies and products. Or in other words, **innovation is based on vocational training**, which is more than just an alternative to studying at a university. It is the basis for a proper professional career.

More than two-thirds of Swiss young people undergo vocational training and might later attend a University for Applied Science. In this setup, the skills and competences of apprentices in each occupation are defined by employers (not colleges or government). And most of the training happens in the company. This is Switzerland’s talent pool with the skillset that industry is looking for.

When the Scottish Minister for Youth Employment in 2013, Angela Constance, visited Switzerland to learn about vocational education, this was an aspect that business highlighted when we visited engineering companies: while it’s good to have a few graduates in the company from the top engineering universities to set the agenda, the best managers you can hire to run your business are those that started on the factory floor.

A study has shown that about **one-third of company innovations** in Switzerland **are initiated by employees in production** rather than by dedicated R&D departments. So, these apprentices are the ultimate drivers of Switzerland’s innovative economy.

Economic framework conditions and **skills development** are key for innovation. But ultimately, you need the **entrepreneurs and the companies** that make it happen.

If you look at Switzerland’s high R&D investments, sectors such as pharma, chemistry, food and engineering make up about half of private sector investments. Obviously, **global companies** like Roche, Novartis, Clariant, Nestlé or ABB with their important R&D investments contribute to a large extent to the Swiss innovation success.

But it is not only the home-grown global companies, but also some **international companies** that came to Switzerland specifically to tap into our research environment, for example IBM's European Research Centre which won two Nobel prizes in the 1980s or Google's 4500-person Development Centre or Disney's Research Studios which develop AI, machine learning and visual computing technologies. Again, their presence in and around Zurich probably says more about Switzerland's innovation capacity than the figures on government R&D expenditure.

But while big companies get most of the publicity, our backbone is **SMEs** which make up 99% of our businesses – like they do in the UK.

Nearly half of these companies rely on **exports** or are part of **international supply chains**. Given the high cost of manufacturing in Switzerland, this is a real challenge in the face of cheaper international competition. The only way to succeed for Swiss SMEs is to offer the latest and best product or service in their niche and to get it right first time and every time. This is only possible if you have the **innovative edge** and the skill at all levels to pull it off.

It is important to remember that despite all the talk about "disruptive innovation" that we hear in management literature, it is "**incremental innovation" and "process innovation"** that can have the biggest economic impact. This is especially true for SMEs which don't have big R&D departments.

Let me mention a couple of examples of where such "**Hidden Champions**" are active:

If you bought a BMW limousine in the 1990s or 2000s you would already have had Swiss nanoparticles in the car paint to make the water pearl off, but if you recently watched a BMW racing in Formula E, it would have contained **composite reinforcement materials made from plants** by Swiss company Bcomp.

While the company Maxon Motors in the rural Canton of Obwalden made foils for Braun shavers in the 1960s, they attempted **to design small electric motors that don't contain iron**. It worked, and now they are the go-to company for drives and gearheads that you will find in insulin pumps and Mars rovers.

When the Swiss mechanical watchmaking industry nosedived in the 1970s, companies turned their **precision engineering** expertise to **medical instruments and implants**, turning Switzerland into a major Medtech hub to this day. Switzerland is home to 10% of Europe's Medtech workforce and Medtech products make up 5% of Swiss exports.

Let's move on to the most dynamic and at the moment most talked about form of innovation: **startups**.

Switzerland clearly has many of the factors that support a dynamic startup environment:

- excellent universities,
- a favourable business climate,
- early stage investors
- and plenty of business talent from global companies and successful SMEs.

Besides government funded training, coaching and networking programmes, the private sector offers venture competitions, innovation parks and accelerators which not only support domestic start-ups but also draw in foreign entrepreneurs. Just to name two examples, the accelerators Mass Challenge and Kickstart Innovation alone work with nearly 150 start-ups

every year in a wide range of sectors (including climate solutions, fintech, health and sustainable food).

With all the great examples of innovation and the significant potential for start-ups in Switzerland, we have to be transparent about the particular Swiss innovation profile. Acceptance of failure or a love of risk might not be the most important elements of the **Swiss entrepreneurial DNA**.

We usually follow a more traditional business mindset, which means that Switzerland is not the best place for startups that rely on speed, agility, promises and government subsidies. But if you have a difficult technology and you need a perfect solution rather than a minimum viable product, then Switzerland is the right place.

The numbers clearly show it: around **400 startups are founded in Switzerland each year** of which around 100 are university spin-outs. Compared to other countries we favour "deep tech" solutions, i.e. areas like Biotech, Medtech, Engineering, Cleantech and Fintech, and we are less active in for example E-Commerce or internet marketplaces.

400 innovative, technology-based startups per annum is a decent number but it is **not huge in international comparison** and represents only 1% of all newly-established Swiss companies. But what's more important is how they perform. **A high proportion of our start-ups are able to survive in the market for more than five years**, which is a good start, but the real judge of quality is of course investment rounds and exits.

Venture Capital investment into Swiss start-ups is up with 3 billion dollars invested last year.

We have a track record of building big companies - with more than 20 unicorns (start-ups that reached a value of 1 billion dollars) in the past 20 years. We are currently placed sixth in Europe. That is more than Spain or Italy have, roughly a third of Germany's, but of course nowhere near the UK with more than 120.

The number of exits has risen dramatically over the past 15 years, reaching record levels last year. There were **11 IPOs last year**, including the sneakers brand "on" which raised nearly $750 million on the stock market.

Clearly our deep tech start-up environment works well and perhaps our careful approach to risk and our love of perfection set a higher bar for founding a start-up, which in turn may well be a reason for success in technology-intensive markets.

Maintaining excellence outside the EU

Science, research and innovation are international endeavours. **Ideas, talents and know-how are rarely confined to borders**. In fact, it is often the diversity of people, cultures and approaches that are at the base of scientific excellence.

Switzerland has traditionally worked closely and successfully with its European neighbours in these fields and we have **strongly contributed to the European science and innovation landscape**. Although we are not a member of the EU, we have been associated to EU research and mobility programmes such as Horizon or Erasmus. And due to the quality of our research, we had the second highest success rate for our proposals, were heading important research consortia and were one of the most successful countries in all ERC calls. In addition,

our scientists and labs are key contributors to international “Big Science” projects like CERN, Iter or the European Space Agency.

Swiss participation in Horizon is currently limited by the EU Commission to **a non-associated third country status**, which provides researchers and innovators in Switzerland a limited participation in around two thirds of the calls for proposals. The UK is in a similar situation.

While we remain **focused on participating in the Horizon Europe** programme, Switzerland has been taking extensive measures (not for the first time) to bridge the gap arising from this situation.

As part of our **transitional measures**, we are now replicating the single researcher elements of Horizon Europe with our own funding. So, for any top researchers in the room: when you see a call for Swiss National Science Foundation “Advanced Grants”, this is your chance to join a fantastic science country, on the terms you would have in the ERC. In addition, we are also funding collaborative research where we are excluded from Horizon, for example in the area of Quantum science.

Complementary to the transitional measures, the Swiss government intends to diversify and strengthen the international reach of Swiss research and innovation in its areas of excellence. In addition to copying Horizon elements, we want **to increase our international science engagement beyond Horizon** and beyond our bilateral jointly-funded programmes with key partners outside the EU. Our new **complementary measures** will start next year, but because we look for **new opportunities** rather than replicating Horizon, these measures take a bit longer to define. We already know that a strengthened international cooperation in space and a **national Quantum initiative** will be part of it, but international partnerships have not yet been defined.

As for the **Swiss-UK science relations**, we now have the unique opportunity to deepen our cooperation. The UK is traditionally one of Switzerland’s most important partners in the area of research and innovation. In the past five years, the **Swiss National Science Foundation has supported more than 3,000 research projects in which Swiss and UK researcher have collaborated**. We both have top science quality, we are innovation leaders and many of our areas of strength are aligned, for example Life Sciences and Biotech, Quantum, AI and space.

This does not only apply to research, but we also have common interests in student mobility. Even though we are both out of Erasmus, our own national schemes, the **Swiss European Mobility Programme and the Turing scheme**, have kept student exchange flowing between our countries. Perhaps it could be further enhanced when a Scottish mobility programme comes on stream?

For this reason, in a few weeks’ time, our two governments will **sign a Memorandum of Understanding to boost our scientific cooperation**. It will be a unique opportunity to bring together **two major science and research platforms in Europe**, not in an attempt to rival Horizon or Erasmus, but to complement our international activities with new alliances that allow all partners to extend their science and innovation capacity.

Conclusion

If a Swiss had answered Orson Welles' rhetorical question about what 500 years of democracy and peace had produced, the answer might not have been as amusing as the cuckoo clock, but might have been more along the lines: Velcro, LCD displays, the internet, DNA, the potato peeler, relativity theory, LSD, instant coffee, cling film, a manned aeroplane that flies around the world on solar power and so on.

For a country with hardly any resources, **research and innovation are key drivers for its economy**. You need a few Thomas Edisons and many John Kruesis to make innovation not an exceptional event but an ongoing process.

Innovation policy is not rocket science. In the case of Switzerland it is a combination of factors that work together successfully. Yes, this includes government policies, first-class universities and funding strategies – but more importantly a love for difficult technologies, a slight obsession with perfection, a dislike of cutting corners and short term solutions, and an appreciation of skills at all levels.

With a few niche exceptions, **Swiss research is driven bottom-up** by researchers' curiosity and sufficient funding to allow long-term research to get high impact publications.

Let me end with an idea for Scottish-Swiss science cooperation: Scotland is rightly proud of its space programme and its growing space industry. Switzerland might not have launching pads, spaceports or a proper space programme, but we have contributed substantially to international space missions, from scientific apparatus to payload cases on Ariane rockets to powering Mars rovers, or our astronauts going to the International Space Station.

Or let me share this anecdote from the Apollo XI moon landing in 1969 (to show that there was more Swissness on this flight than the Omega watches): the second thing that was unfolded by Buzz Aldrin and planted on the surface of the moon was the American flag. The first thing was a flag-like sheet to measure solar **wind designed and built by the University of Berne**.