

# Microtechnology and Nanotechnology in **Switzerland**



# The High Economical Potential of Micro and Nanotechnologies

Scientists and politicians share the same opinion: micro and nanotechnologies have a high economical potential worldwide. The convergence of major scientific and technological disciplines such as physics, biology, chemistry, material sciences and computing is creating an enormous potential for new applications.

Micro and nanotechnologies go hand in hand with the further development of existing and revolutionary handling and production technologies. The making of the smallest structures often requires completely new methods of thinking. The development of high-precision instrumentation is a challenge and a key to successful exploitation of micro and nanotechnologies. Advances in process technologies such as coating, replication and microrobotics will pave the way to the industrial applications of nanotechnology.

Micro and nanotechnologies are characterized by a high degree of interdisciplinary cooperation between those involved in the widest sphere of sciences and technologies. There is the key for the development of highly innovative applications with an enormous economical potential in almost all branches of industry:

- Information and communication technologies
- Medical technology, biotechnology and pharmacology
- Environmental protection
- High-precision optics
- Semiconductor technology
- Construction industry
- Engineering
- Motor vehicle manufacture
- Chemistry



## Definition and Examples of Micro and Nanotechnologies

The various fields of micro and nanotechnologies can be divided up in three groups:

- **Materials**, covering the research and application of new types of materials, including the research on the characteristics of micro or nano-structures. Some examples: Nanopowders for drug delivery systems, specifically designed supramolecules with novel properties, ultra-thin coating layers and biomaterials characterized by controlled interaction with organic molecules.
- **Handling and production**, covering the development of high-precision manufacturing and measuring processes, along with the tools and instrumentation. Some examples: Fabrication of nanostructured dirt-repelling surfaces, replication of optical microlenses, next generation lithography (NGL) for the semiconductor industry, ultra-high-precision assembly tools and the atomic force microscope (AFM) for the characterization and manipulation of nanosized structures.
- **Components and systems**, covering activities related active and passive components as well as their integration into overall systems. Some examples: Optical micro-electromechanical systems (Optical-MEMS) for switches of optical communication networks, AFM cantilever arrays for novel data storage solutions, vaporizers for inhalators, microfluidic nozzles for DNA analyses in biomedical applications.

# Switzerland is a **Leader** in Research and Education

## Switzerland Ranks Top in High Technology Research

Relative to GDP, Switzerland allocates close to 0.8% of GDP to basic research, which is almost twice as much as the respective figures for the United States and Japan. In Switzerland, approximately 75% of basic research is performed by the higher education sector, while the other quarter is performed by the business sector.

Switzerland annually grants more than USD 16,7 million for research in nanotechnology and related fields. On a per capita basis, Switzerland's commitment is the highest in the world!

Swiss academic institutions enjoy internationally an outstanding scientific reputation. The research activities in micro and nanotechnologies cover the whole spectrum, from material science to handling and production technologies all the way through to the research and development of components and systems.

About the attractiveness of Switzerland as a location for nanotechnology:

'Thanks to high technical standards in education and know-how as well as the outstanding sense for precision in thinking and action on all levels, from vocational education to top performance in the field of science which is attractive for professionals and scientists worldwide, Switzerland represents an excellent location for nanotechnology.'

### Dr Heinrich Rohrer

Nobel Laureate in Physics in 1986 for the design of the scanning tunneling microscope

## Switzerland well Placed to Develop High Tech Industries

Switzerland takes first place in an OECD study in terms of expanding the knowledge intensive industries of the 21st Century. In particular, it ranks first in innovation and entrepreneurship and is best positioned to acquire the new skills and technology necessary for the leading edge industries of the future.

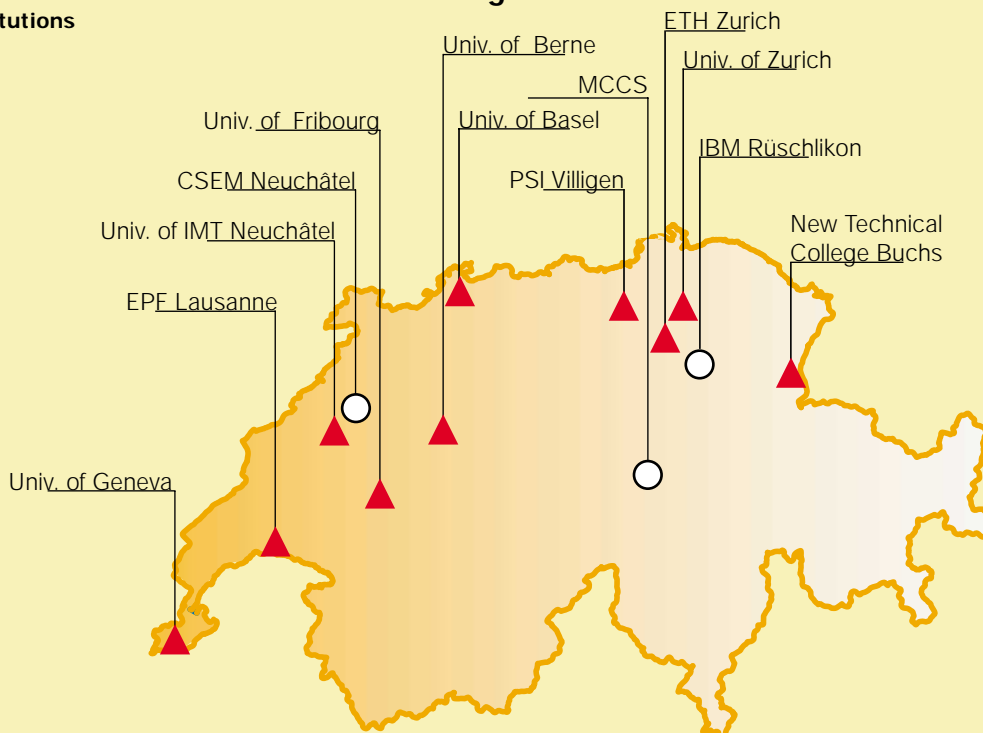
Switzerland is high in the individual league tables rating the level of both knowledge-based services and high- and medium-technology manufacturing as a proportion of its total economy. More than a third of economic output in Switzerland falls into these categories- more than in any other country.

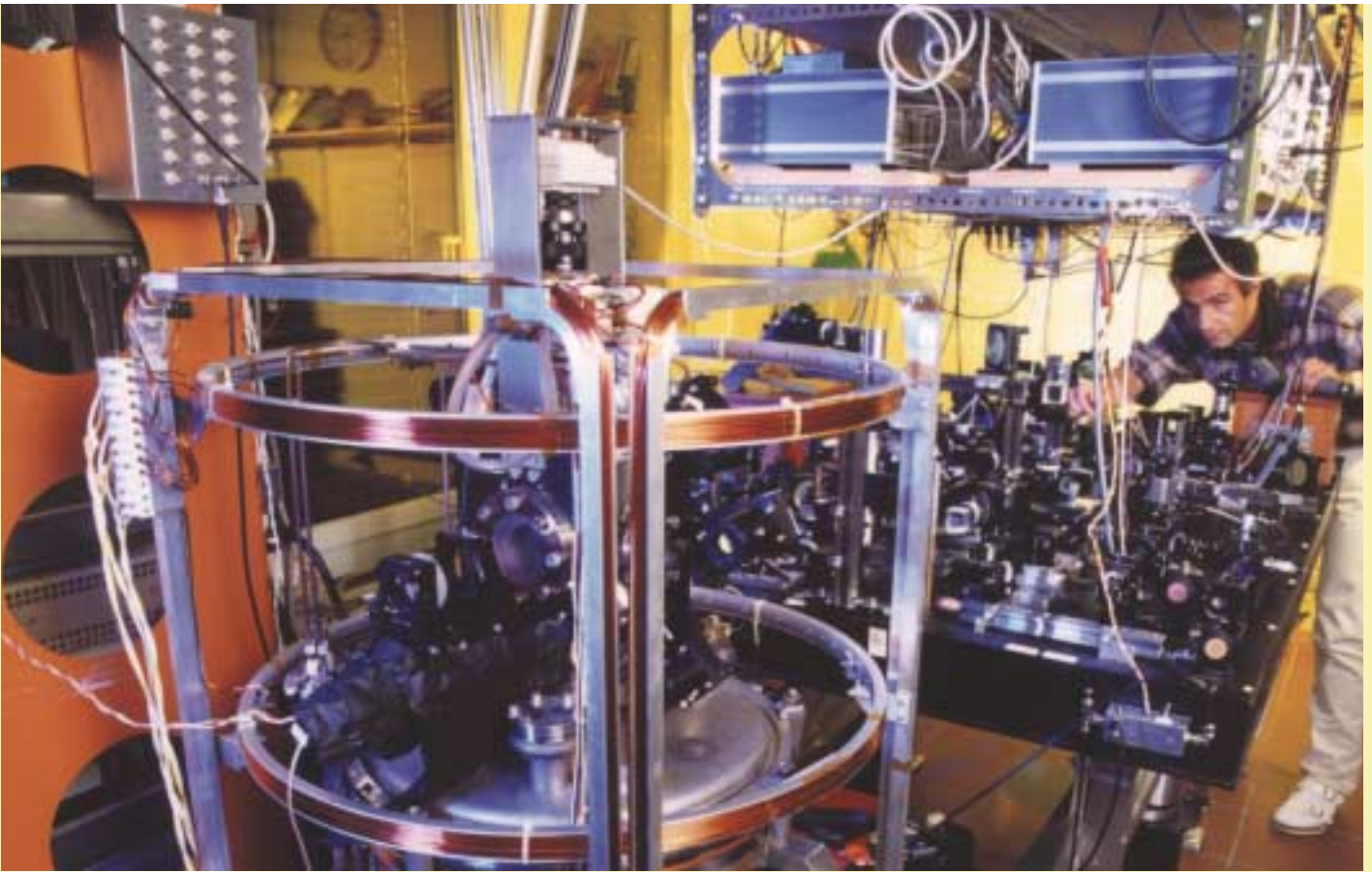
Source: OECD, Science Technology and Innovation Scoreboard, 2001

○ Private research centers with significant activities in micro and nanotechnologies

▲ Academic Institutions

## Academic institutions and private research centers of national significance in the exploitation of micro and nanotechnologies.

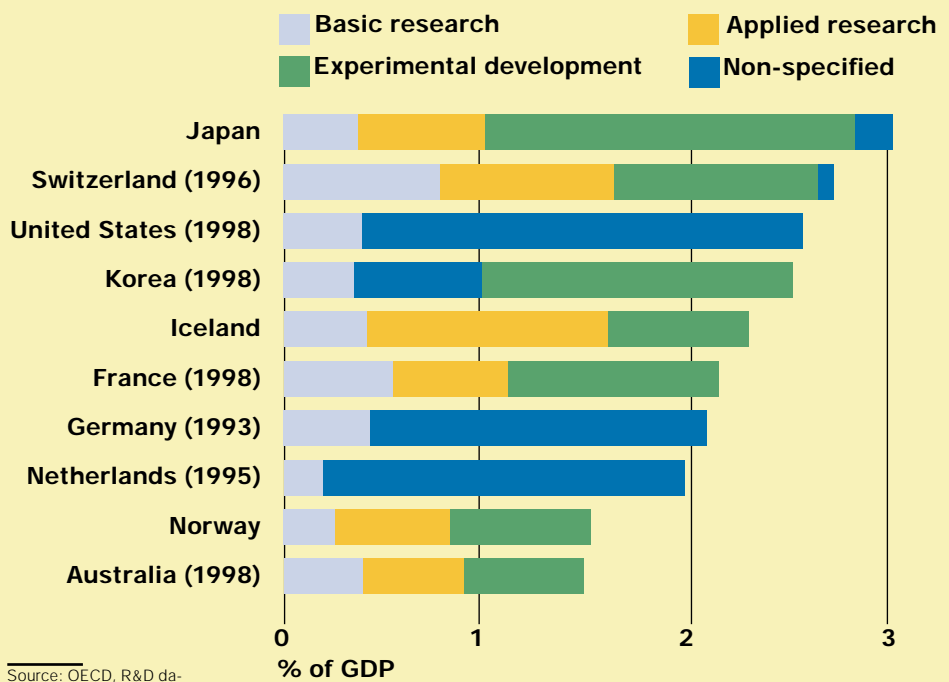




### Switzerland's Significant Contribution to International Research Programs

Switzerland is significantly engaged in pan-European and international research programs. And hence, the intensive exchange of know-how ensures that Switzerland's academic institutions are in possession of state-of-the-art know-how.

Breakdown of R&D expenditures by type of research as a percentage of GDP, 1999



Source: OECD, R&D database, May 2001



# A Qualified and Productive Workforce

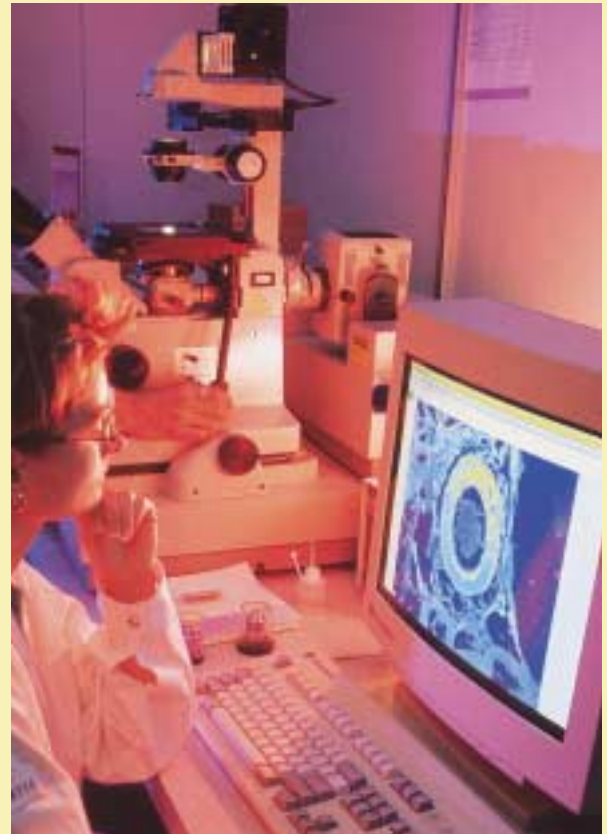
A skilled, entrepreneurial and productive workforce has always been key for the success of a company. For companies dealing with micro and nanotechnologies, this prerequisite is even more important.

- Switzerland's vocational training system is geared to the needs of science and business. A majority of young people completes an apprenticeship and obtains practice-oriented training 'on-the-job'.
- Switzerland can claim three of the most used languages in Europe – German, French and Italian – as its national languages. English is also used and spoken and commonly accepted as the main business language in Switzerland.
- More than 16% of the country's total active workforce comes from EU countries. The Bilateral Agreements with the European Union will allow free movement of labor which will further increase the availability of a skilled and multilingual workforce.

Just looking at pure salaries paid in Switzerland, one might think that Swiss labor costs are comparatively high. However, when analyzing the total cost of personnel to the employer, the following factors should be considered:

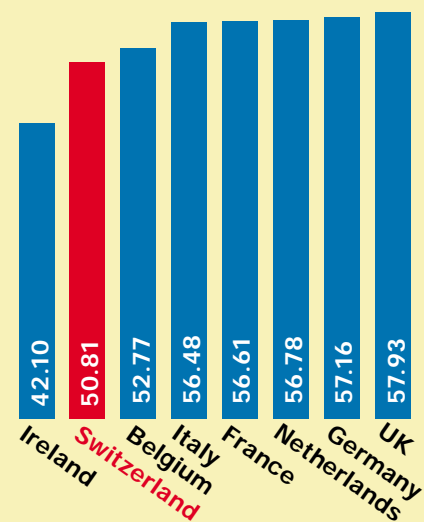
- Switzerland has lower additional payroll costs in terms of social security contributions than most other European countries.
- Swiss employees are amongst the most productive work forces worldwide, in terms of value added per hour worked.
- With an average of 1,856 annual working hours per year, people in Switzerland work more than in all other European countries.

Taking into account these factors, labor costs in Switzerland turn out to be, as a whole, attractive relative to international standards.



## Annual Salaries Adjusted to Productivity (in USD)

Example:  
Pre-Sales Support Specialist



Source: Corporate Consulting & Technology (CC&T), Galileo Group, Geneva, May 2000. Productivity is recognized as an index based on the GDP per person employed in 1999 (in USD). The productivity adjustment was calculated by total salary cost x 100 / productivity index.

# High Quality and Efficient Operating Environment

## Efficient research cooperation between academia and industry

Switzerland fosters actively cooperation between academia and industry via a number of national research programs. The key programs contributing to the development of micro and nanotechnologies are:

- **TOP NANO 21:**  
This program is an initiative of the Federal Institutes of Technology Board. Its goal is furthering activities in the research and application of nanotechnology. Cooperative projects, headed by the Commission for Technology and Innovation (CTI), are being carried out between universities and industrial partners.
- **National Center of Competence in Research (NCCR) in Nanosciences:**  
This program is devoted to the search for new impulses with regard to life sciences, sustainability, new information and communications technologies. Five principal fields of endeavour take center stage in this research program:
  - Life sciences
  - Molecular machines and nano-robots
  - Quantum computing and quantum communication
  - Nanosciences at the extremities of today's production, manipulation and measurement methods
  - Nanomaterials – from biological systems to nano-clusters
- **NCCR in quantum photonics:**  
This research program is dedicated to research in
  - Quantum communication, i.e. the use of the quantified characteristics of light for the transmission and processing of data
  - Optical nanotechnology enabling the investigation of chemical and biological processes at the molecular level
  - Photon sources with improved performance
  - Photonic components and systems used in optic communications
- **National Research Program on Functional Supramolecular Materials:**  
Highly organized molecular systems constitute the main research theme of this focal program. The aim is to create small groups of molecules – supermolecules – from organic and non-organic units or from fragments of bio-molecules, so that they can offer new and carefully planned properties.

'Due to joint efforts between the private and public sectors during the last decade, Switzerland has built up a unique R&D platform as well as an industrial expertise in the field of micro and nanotechnologies. A strong network of state-of-the-art facilities exists throughout the country, which supports R&D programs from demonstrator activities up to mass fabrication of microsystem components.'

**Prof. Dr Nico De Rooij**, Institute of Microtechnology, IMT, University of Neuchâtel

'ILFORD has been active in materials at the micron level for a long time as a photographic manufacturer. Our move into nanotechnology (fast drying nanoporous ink jet material) was however only possible due to the presence of the required expertise in nanopowders at the EPF Lausanne, plus our ability to access and pay for this expertise through a Swiss CTI project. We have identified further new technology opportunities through the TOP NANO 21 program that groups universities and industry in an open and constructive manner.'

**Dr David Tune**, Director of Technology and Innovation, ILFORD Imaging Switzerland GmbH

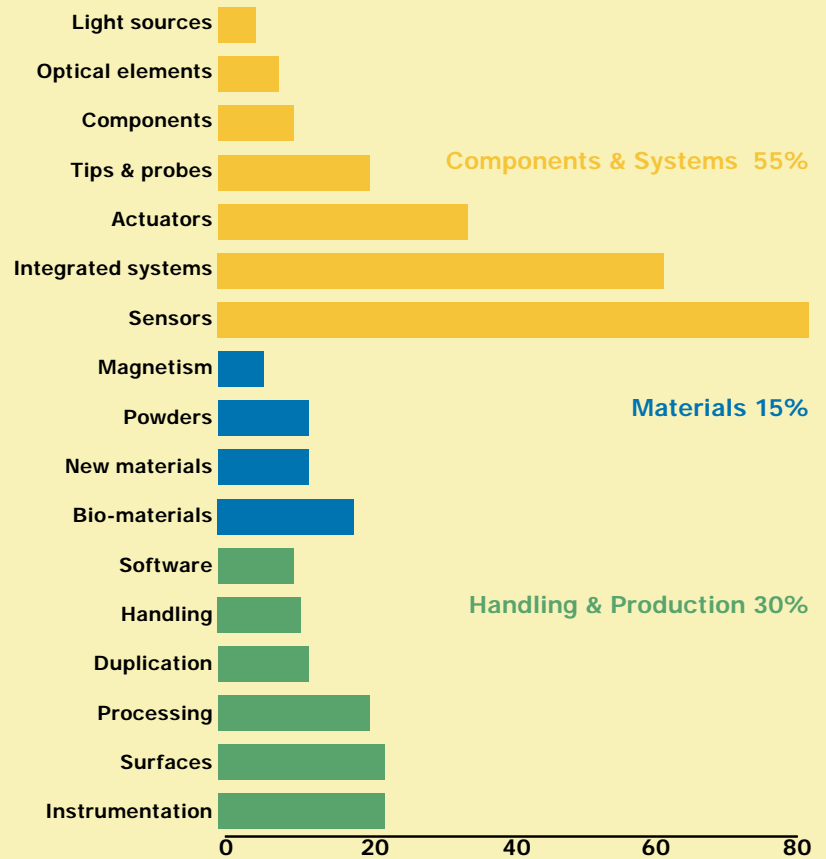
'IBM's Zurich Research Laboratory plays a worldwide recognized leading role in the field of nanotechnology. The pioneering work is based not only on unique expertise and fundamental inventions but also on close collaboration and interaction with academia and industrial partners. Switzerland is an attractive place to work for scientists and engineers from all over Europe and beyond, and many high quality efforts at universities and in high-tech companies of the country provide the stimulating environment required for a continuous flow of scientific and technological advances.'

**Dr Erich Ruetsche**, Program Manager Business Development, IBM Research Zurich

## Research Laboratories

The main private, semi-public and public research laboratories actively participate to the vibrant technological competency network. Among those are

- IBM Research Laboratory in Rüschlikon  
Nanoscience has a long tradition at IBM's Zurich Research Laboratory. It represents the European branch of IBM's worldwide research organization, based on IBM Zurich scientists' inventions of the Nobel Prize winning scanning tunneling microscope and the atomic force microscope as crucial tools for the field. Today's projects encompass novel applications of scanning probe methods and related techniques. One of the goals is to construct functional components and devices out of nature's fundamental building blocks on the nanometer scale. A novel data storage concept and sensors based on nano-mechanical techniques are promising developments as well.
- Centre Suisse d'Electronique et Microtechnique (CSEM) in Neuchâtel  
CSEM is a private company that has become a powerful link between university-based research and industrial application of new technologies. CSEM is mainly active in the areas of microtechnology, micro-electronics and information systems. CSEM develops and exploits key technologies with the help of the Swiss Confederation, universities and industrial partners. CSEM is prominently represented in many national research programs that foster the cooperation between academia and industry.
- Paul Scherrer Institute (PSI) in Villigen  
PSI houses the Laboratory for micro and nanotechnologies (LMN) that devotes its efforts to application-oriented and fundamental research in the selected areas of micro and nanotechnologies. The PSI is also renowned for its new facility, the Swiss Light Source (SLS), making high-quality synchrotron X-ray beams available to the research community. Various beamlines are suitable for investigations of the structural and chemical properties for a wide range of materials. Techniques of particular relevance to industry include protein crystallography for drug design, powder diffraction for structural analysis of materials and spectro-microscopy for the compositional analysis of surfaces and thin films.



## Number of Academic and Industrial Partners

Distribution of joint academic and industrial activities in subfields of micro and nanotechnologies  
Sources: MINAST, Priority Program MINAST of the Board of the Swiss Federal Institutes of Technology, MINAST News 4/1999, Final Report and TOP NANO 21, First Annual Report 2000, Board of the Swiss Federal Institutes of Technology and the Commission for Technology and Innovation (CTI), October 2000

- Micro Center Central Switzerland AG (MCCS) is a joint venture with the governments of the central Swiss cantons (UR, SZ, NW, OW, LU, ZG). MCCS collaborates with the CSEM in Neuchâtel and does research and development activities in microrobotics, microsystem technology, optics, communication and electronic design. MCCS is nurturing a network involving universities and colleges of advanced technology.

# Business Friendly Tax Environment

The tax environment is a key factor in deciding where to locate your company. Switzerland offers high tech companies a very favorable tax environment with moderate overall taxation, which continues to be under downward pressure within Switzerland due to healthy tax and location competition between the 26 cantons in Switzerland.

## Moderate overall taxation

Taxable income in Switzerland is determined based on the financial statements prepared in accordance with relevant local accounting principles. Depending on the nature of the company in Switzerland and the defined tax and legal structure, the profit assessable in Switzerland may, however, differ. In order to limit the number of litigious cases, the Swiss Tax Administration commonly attributes to companies a notional profit upon which tax is levied. Where co-ordination or management services are offered to group companies (e.g. technical, administrative or scientific assistance, including research and promotion activities), the profit assessable in Switzerland is generally considered to be 5% of total overhead.

Swiss federal corporate income tax is levied at a flat pre-tax rate of 7.83%. When cantonal and communal income taxes are also considered, the overall ordinary tax rates can vary between 7.83% to 25%, which is a very moderate level compared to other European countries.

## Attractive withholding tax regime

Switzerland has a comprehensive network of income and capital tax treaties that allow for repatriation of profits with no or minor final withholding tax burden. Furthermore, Switzerland basically does not levy withholding tax on interest or royalty payments to foreign companies. Additionally, Switzerland has no controlled foreign corporation (CFC) laws in place, making Switzerland very attractive compared to most other European countries.

In addition, depending on the number of jobs created in Switzerland, full or partial income and capital tax relief may be granted on federal, cantonal and municipal levels for up to ten years.

## Co-operative tax authorities

Aside from the low income tax burden, Switzerland is known for a traditionally co-operative and constructive relationship between taxpayers and tax authorities. Combined with the widely used possibility of obtaining advance tax rulings in order to minimize future tax risks, the Swiss tax system is a further asset for the success of your company.



Country	Corporate income tax rate (%)
Switzerland	7.83–25
Sweden	28
UK	30
Denmark	30
Netherlands	35
France	36.4
Belgium	40.17
Germany	38–41.5

Source: Andersen, 2001



# Interaction Between Clusters

## Little Switzerland – A High-Tech Boutique

Within only four hours traveling time, Switzerland combines world-class research, internationally successful high-tech companies and a renowned financial market place.

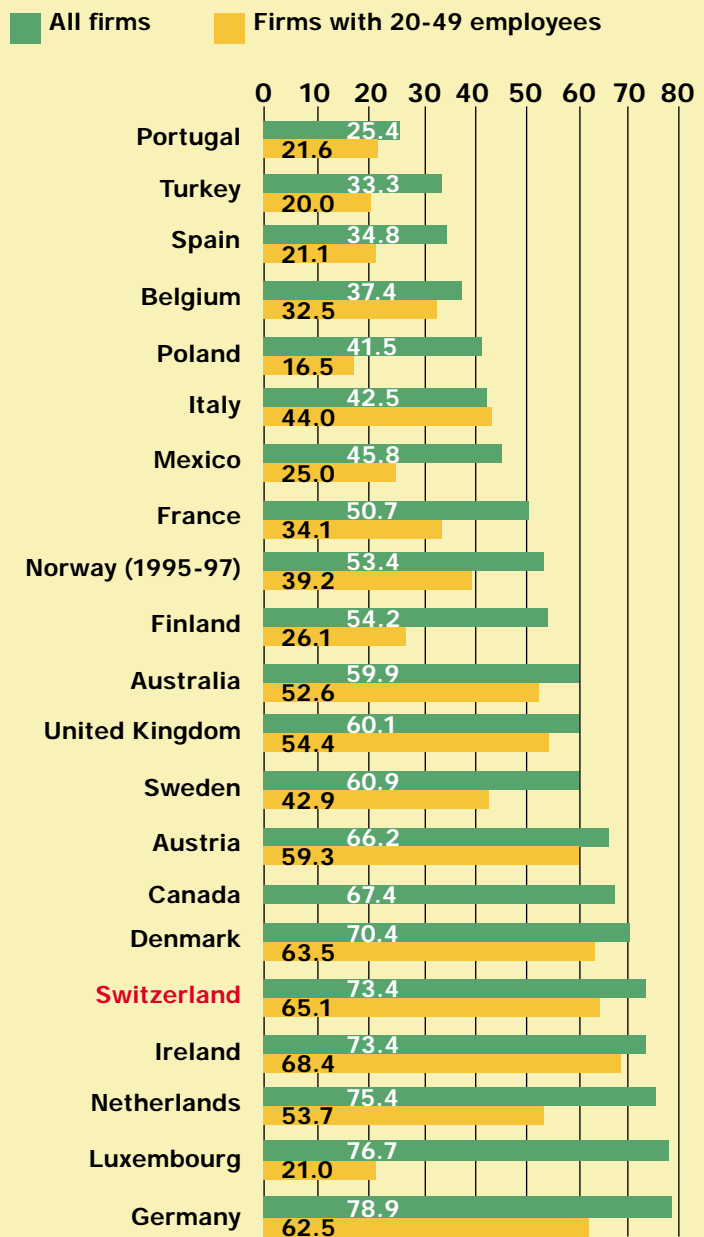
The uniquely high concentration and versatility of capabilities within short distances lead to significant advantages for companies active in micro and nanotechnologies:

- Easy establishment of contacts with competent partners in similar or complementary technological fields
- Access to resources with experience in relevant technologies and markets
- Favorable conditions for technology and knowledge transfer
- Easy observation of technological developments in other markets due to the vicinity of industries and research

'As an experienced venture capitalist and entrepreneur I do not know a more favorable place around the world than Switzerland where a high-tech company can be built: We have highly skilled people, an incomparable density of specialists within short distances and favorable taxes.'

**Philipp Bachmann**, Entrepreneur / Consultant  
Aritron

Share of firms in the manufacturing sector introducing new or technologically improved products or processes on the market, weighted by number of employees.



Source: Eurostat; OECD, STI/EAS Division, May 2001

# Companies with Significant Activities in Micro and Nanotechnologies

Some characteristics of the company landscape:

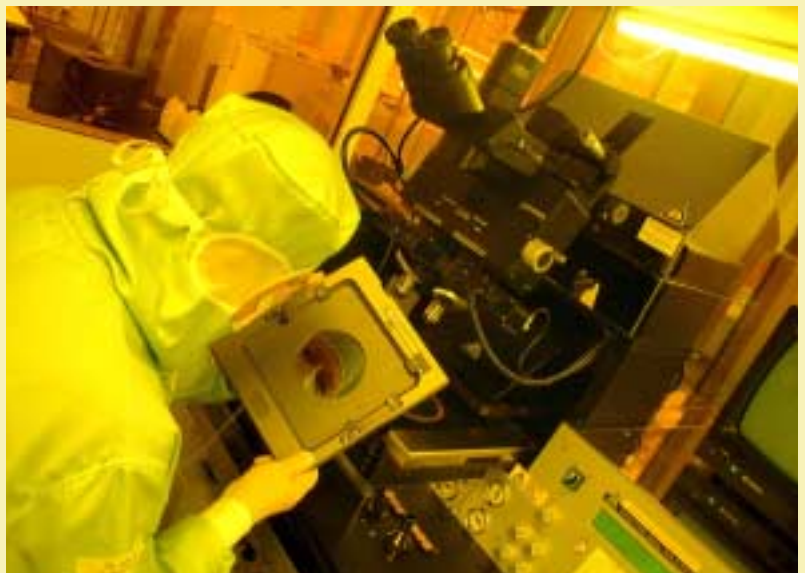
- More than 120 companies active in the development of micro and nanotechnologies are cooperating with Swiss academia.
- Small- and medium-sized enterprises predominate the corporate landscape.
- About 50% of the companies active in micro and nanotechnologies have fewer than 50 employees.
- In larger companies, the micro and nanotechnology workforce is typically less than 50

A choice of Swiss companies with significant activities in micro and nanotechnologies:

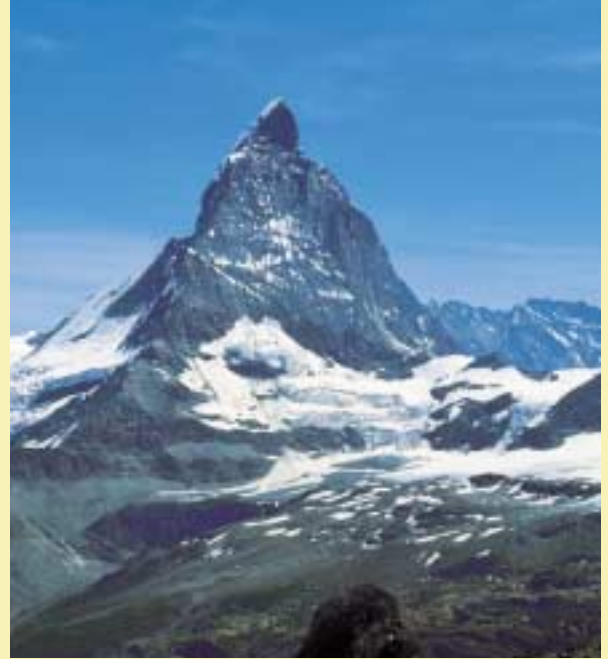
- Centre Suisse d'Electronique et Microtechnique (CSEM), Neuchâtel
- Disetronic Medical Systems AG, Burgdorf
- ETA SA, Grenchen
- Fisba Optik AG, St. Gallen
- Leica Geosystems AG, Heerbrugg
- Leister Process Technologies, Sarnen
- Nanosurf AG, Liestal
- Phonak AG, Stäfa
- Reinhard Microtech, Wangs
- Roche Diagnostics, Rotkreuz
- Sensirion AG, Zürich
- SwissOptic AG, Heerbrugg
- Weidmann Plastics Technology, Rapperswil
- Zeptosens AG, Witterswil

And, a range of international companies have also located part of their research and development activities in Switzerland, including:

- Dspfactory (Canada)
- IBM Research (USA)
- ILFORD Imaging (GB)
- Karl Süss (Germany)
- Nortel Networks (USA)
- Siemens Building Technologies (Germany)
- Tokyo Electron (Japan)



# From a High Quality of Life to a Supportive Administration



## A high standard of living

Switzerland, with its reputation for having a high standard of living, is an attractive choice also from an individual's standpoint:

Unemployment and crime are very low. Residential areas are attractive and have generally a high standard of living. A broad network of hospitals and well-known public and private hospitals and clinics ensure a complete coverage of medical services around the country. Most cities have particularly important international, cosmopolitan communities. As a result, they have many international and English-speaking clubs and associations as well as international primary and secondary schools, whose quality is widely recognized. The public school system, which is free, is top-rated, as are Switzerland's universities.

## Supportive authorities

About a quarter of Switzerland's territory has been designated as belonging to an economic renewal area, thereby being eligible for special support from both federal and cantonal authorities. Federal and cantonal authorities can provide financial help in these economic renewal areas. Depending on the location, all 26 cantons in Switzerland offer financial support available at the municipal and cantonal level.

## Additional services to support newly established companies

In addition to tax relief and financial support, the cantonal economic development agencies provide a broad range of services in close co-operation with banks, notaries, lawyers, fiduciary companies and consultants, including:

- support with administrative matters, e.g. obtaining permits for construction, residence and work permits, examination of legal issues;
- acceleration of public administrative procedures;
- advice when looking for land;
- introduction to business partners and advisers;
- a link to other authorities.

## Global Ranking of High Quality of Life Cities

Ranking	City	Country
1	Vancouver	Canada
2	Zurich	Switzerland
3	Wien	Austria
4	Bern	Switzerland
5	Sidney	Australia
6	Geneva	Switzerland
7	Auckland	New Zealand
8	Copenhagen	Denmark
9	Helsinki	Finland
10	Amsterdam	Netherlands

Source: William M. Mercer Companies LLC, Worldwide Quality of Living Survey 2000

Note that Switzerland has 26 cantons that have their own programs with special incentives that may be adapted to your company's needs. Each of the cantons has experts who are able to assess your individual company project and to suggest a location best suited to your requirements.

# Switzerland – a Leading Financial Center



## SWX Swiss Exchange

The SWX Swiss Exchange is one of the world's leading and most technologically advanced securities exchanges. In 1996, floor-based trading in Switzerland was supplanted by electronic trading. This fully automated trading, clearing and settlement system remains unique in the world. The SWX Swiss Exchange offers its customers first-rate securities exchange services and a broad range of investment products.

Through its various shareholdings and alliances, the SWX Swiss Exchange is active on an international scale. It offers cross border integrated solutions in specific securities market segments: be it in the form of Eurex, the world's number one derivatives exchange; virt-x, the first pan-European exchange for the fully integrated trading of blue-chip shares; STOXX, with its established family of benchmark indices; or EXFEED, a provider of international raw financial data.

[www.swx.com](http://www.swx.com)

'For us, micro and nanotechnologies is of central significance. Not long ago, we launched the SWX New Market, a market segment that is focused on companies in this industry. We also actively foster knowledge transfer between the research, industrial and financial sectors in regard to this young field of enterprise, for example by initiating and financing a study aimed at increasing its transparency and visibility.'

**Dr. Heinrich Henckel**, Chief Executive Officer  
SWX Swiss Exchange



Switzerland's highly developed and effective banking system makes it possible to secure financing on favorable terms and ensures access to the most modern financial instruments as well as comprehensive advice. In addition to the major international Swiss banks, there are a large number of private, cantonal and regional banks, all in all more than 370 financial institutions and over 140 foreign banks. Switzerland holds a worldwide leading position in cross border private banking and is one of Europe's leading financial centers for equity-investing institutions.



## Initial Public Offerings

IPOs are highly attractive in Switzerland. Home already to a host of Swiss blue-chip shares such as ABB, CS Group, Kudelski, Novartis, Roche, Serono, Sulzer, UBS, Unaxis and Zurich Financial Services, the SWX Swiss Exchange is also a very attractive venue for IPOs. Securities issues benefit from the influential role played by institutional investors and the substantial presence of foreign market participants. The SWX Swiss Exchange makes available various market segments in which companies can list their shares. The listing and maintenance requirements for those segments have been conceived to meet the specific needs of investors.

While the legal requirements for initial public offerings reflect European standards, the related listing costs in Switzerland are well below average. In contrast to NASDAQ Stock Market, where nearly 4,300 companies vie for the favor of investors, much less effort is required in the Swiss financial marketplace for firms seeking to successfully establish themselves among investors.

## SWX New Market

The SWX New Market offers a financing platform for companies from growth industries such as life science (pharmaceutical, medical, biotechnology, etc.) and information technology (Internet, software, telecom, multimedia etc.), in which micro and nanotechnologies play an increasingly important role. This concentration in a separate market segment is aimed at arousing the interest of international investors and helping the listed companies to benefit from the sector-specific know-how of analysts and portfolio managers.

## Private Equity and Venture Capital

Switzerland is home to a broad array of venture capital and private equity funds and investment companies that are active in financing micro and nanotechnologies applications in the life science and IT sectors. A wide spectrum of business and financial support is available to assist start-up and spin-off companies in all stages of their business development.

## Listing requirements

Segment Requirements	SWX Main Market	SWX New Market	SWX Local Caps
Track Record	3 years	1 year	2 years
Market Making	no	yes (2 years)	no
Analyst Reports	no	yes (2x2)	no
Equity (CHF)	25 mn	2.5 mn	2.5 mn
Market Cap(CHF)	25 mn	8 mn (free float)	10 mn
Free Float	25%	20%	15%
Lock-up	no	6 months	no
Min. No of Share	no	100'000	no
Capital Increase	no	yes (min. 50%)	no
Accounting Standards	FER, IAS, US-GAAP + other standards	IAS, US-GAAP	FER, IAS, US-GAAP + other standards
Interim Reports	half-yearly	quarterly	half-yearly
Ad Hoc Publicity	yes	yes	yes

## Selection of investment companies and venture capital firms in Switzerland

### Investment companies listed on the SWX Swiss Exchange

BB Biotech  
BB Hitech  
BB Medtech  
Castle Private Equity  
Incentive Capital  
Micro Value AG  
New Venturetec  
Private Equity Holding AG

### Venture capital companies

Alta Berkeley Venture Partners  
Apax Partners  
Aventic Partners AG  
HBM Partners AG  
New Medical Technologies  
Novartis Venture Fund  
Nextech Venture  
Partners Group  
TAT Capital Partners  
Venture Partners

A list is available on [www.seca.ch](http://www.seca.ch)

### Further information:

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# We Are **Ready** When You Are...

Micro and nanotechnologies open up an enormous market potential. Switzerland holds a strong position in these technologies – clearly stronger than its size would indicate. In several fields, Switzerland even has a considerable lead. This brochure on micro and nanotechnologies is a first introduction to remind you that in Switzerland, you will be able to find:

- A highly productive and skilled workforce
- A flexible labor market
- A liberal regulatory framework
- Low corporate and individual taxes and moderate ancillary labor costs
- An excellent communication and transportation infrastructure
- A central location close to your operating business units
- High quality of life and a cosmopolitan environment
- Attractive incentives and public support
- Efficient and business friendly public administration

More information on doing business in Switzerland is also available in our Handbook for Investors, which contains everything; you and your advisers need to know in making your site decision. You will readily notice that it is easy and uncomplicated to start a business in our country.

Our senior representatives for Europe and North America will gladly assist you. As soon as you have identified where in Switzerland you would like to invest, you can count further on the professional and efficient consultation and support services of the Cantonal and regional industry and trade promotion offices.

Whether you are a sizeable investor or an entrepreneur, you are personally welcome in our country. You have my word on it!



**Mr David Syz**  
State Secretary for Economic  
Affairs seco



# Investing and Doing Business in Switzerland

**Location: Switzerland will be pleased to provide you with further information about Switzerland as a location for your company.**

Please visit our website under:

**[www.locationswitzerland.ch](http://www.locationswitzerland.ch)  
or [www.swissemb.org/Is](http://www.swissemb.org/Is)**

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# Other Useful Addresses

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The information contained in this brochure is correct to the best of our knowledge and belief at the time of printing. It is, however, intended as general information. We recommend that specific professional advice is sought before any action is taken.

The SWX New Market has commissioned a study on the Swiss competency network in the field of micro and nanotechnologies. The study was conducted between the autumn of 2000 and summer 2001 with the help of experts in the field and managed by the Swiss Technology Consulting Group AG. It constitutes the basis for this seco publication and can be accessed free of charge on the Internet at [www.swx.com/products/swxnm\\_sectorinfo\\_en.html](http://www.swx.com/products/swxnm_sectorinfo_en.html).