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## Executive Summary

Research intensity measured by gross domestic expenditures on R&D (GERD) was 3% in 2008 and 2009 in Switzerland, which is substantially higher than the average in the EU-27 of about 2%. This high level of expenditures is largely due to the private sector. The Swiss research system is of very good quality and shows a distinct organisation, based on a clear-cut separation between the public sector, centred on very research-intensive universities, and the private sector, centred on the large research units of multinational companies. The Swiss higher education system consists of ten cantonal universities, two Federal Institutes of Technology and nine Universities of Applied Sciences (UAS) (7 public and 2 private). Public research institutes are relatively unimportant. Political responsibilities for research and higher education are divided between the central state (Confederation) and the regional authorities (the Cantons). At the federal level, responsibilities in respect to research and higher education are divided between the Federal Department of Internal Affairs and the Federal Department of Economic Affairs. The Federal Department of Internal Affairs is responsible for universities and support to basic research, whereas the Department of Economic Affairs is responsible for the UAS and the support to applied research. The Swiss National Science Foundation (SNF) and the Swiss Innovation Promotion Agency (CTI) are the institutions that are responsible for support of basic research and innovation and are headed by the Federal Department of Internal Affairs and the Federal Department of Economic Affairs, respectively. On the whole, universities (including the ETH domain) have a dominant role in the public research sector and public research laboratories are rather weak although there are a few notable institutions within the ETH domain. In addition, private research is strongly concentrated in the chemical and pharmaceutical sector and in the (electro) mechanical industry (including precision instruments).

Swiss research policy is characterised by continuity and stability. This is also true for the level of R&D spending meaning that the level of budgets is often sufficient, but increases are rather small. Important characteristics of R&D funding in Switzerland are the high priority of competition in selecting targets for funding, the bottom-up principle in defining the content, and the lack of instruments to directly support private R&D. In recent years, Switzerland has made good progress in achieving national R&D investment targets where the Federal Council aims for a growth rate of expenditures for education, research and innovation of 4.5% per year. Between 2008 and 2011 expenditures even grew by 6% per year. On the whole, the strategic plan for 2012 foresees to freeze public investments in 2012 to the originally planned level of 2011. The 2012 plan is an extension of the 2008-2011 strategy because challenges and framework conditions have not changed significantly in the meantime.

The main structural challenges of the Swiss RDI system can be summarized as follows:

- The dependency on private-sector research. With worsened economic prospects and companies cutting their R&D budgets, Switzerland could lose its very good position in the level of R&D intensity and innovation output because of a lack of funding for applied research and innovative activities. The state possesses little scope to influence the R&D strategies of large companies. In addition, these companies reflect rather conservative sectors.
- The lack of a systematic mechanism to identify knowledge demands. Knowledge demand is characterised by a strong bottom-up approach and an extensive involvement of social and economic stakeholders in the design of research policy

where decision on research direction is left to researchers and private companies. Hence, there are few policy instruments focusing on thematic priorities. While this model has proven to be very effective, it drives to a fragmentation of research policy and to a largely incremental practice in setting priorities and allocating financial means.

- The fragmentation of the higher educational system, the slow pace of reforms in this domain, and little influence of policies on knowledge production in the private sector. A challenge is also the lack of skilled workers.
- A lack of systematic policy for knowledge circulation and coordination between research and innovation policy as well as between federal and cantonal tasks and tasks of the Federal Department of Internal Affairs and the Federal Department of Economic Affairs.

The main priority of Swiss national research and innovation policies is simply to provide excellent framework conditions by fostering basic as well as applied research and technology transfer. Further goals are to sustain the ability to compete internationally in all domains and to promote better coordination between research and innovation policy. Therefore, the Federal Council considers a stronger use of basic research for the promotion of innovation and a stronger coordination between SNF, CTI and the private sector as well as support of cooperation between different research groups as important. Obviously, there is an attempt to reduce fragmentation both at the federal level and between the federal and cantonal levels. First, the responsibilities for research, innovation and education will be assembled in one ministry in future. Second, steering and monitoring of universities will be done together by Cantons and the Federation. Also, strengthening coordination between research and innovation policy may lead to an even better satisfaction of knowledge demand. However, given the stability of Swiss policies, it is unlikely that there will be many fundamental changes in the RDI system in future, especially in terms of funding mechanisms that will still be competitive and follow the bottom-up principle. Although incremental changes have been sufficient in a well-functioning RDI system, under increasing international competition, concerns, often articulated in ERI messages, are warranted on whether and how Switzerland can sustain its very good position with this strategy.

The policy mix seems to be well-balanced and in line with the major needs of the RDI system. The Swiss research and innovation policy is focused towards strengthening the knowledge base, and fundamental and applied research. Innovation is fostered by knowledge transfer and public-private cooperation although direct funding mechanisms for firms are mostly non-existent. Strategic intelligence to come up against challenges with concrete measures is lacking because knowledge demand is defined according to the bottom-up principle. The political system of Switzerland ensures that all relevant stakeholders are included in decision-making. Public investment in research and innovation can be considered predictable and stable although there are only incremental increases in related budgets. Excellence, high quality and competition are important criteria for the allocation of funds. Projects are generally selected according to the quality of proposals which is in line with the bottom-up principle. Universities enjoy a relatively high degree of autonomy. Employment conditions for researchers are very good in terms of salaries and provide incentives to attract international talent. Partnerships between higher education institutes, research centres and businesses are actively promoted.

By and large Swiss research policy complies with ERA objectives. For example, the Swiss researchers market is one of the most open internationally. In the domains of research

infrastructures and opening of research programmes, Switzerland is following the decentralised and bottom-up approach which broadly characterises its research policy. Thus, participation in European infrastructural initiatives and international programmes, as well as opening of national programmes, is decided case by case when the research community shows an interest for them.

The bottom-up approach and the focus on funding of basic as well as applied research coupled with competitive funds for joint public-private research projects has to be judged positively given the Swiss tradition of delegating as many responsibilities as possible to researchers in defining their priorities. However, the political level should develop a clear framework of coordination between research and innovation policy in order to build a bridge between both domains.

## TABLE OF CONTENTS

1	Introduction.....	7
2	Structural challenges faced by the national system.....	10
3	Assessment of the national innovation strategy .....	13
3.1	National research and innovation priorities .....	13
3.2	Trends in R&D funding.....	16
3.3	Evolution and analysis of the policy mixes .....	19
3.4	Assessment of the policy mix .....	20
4	National policy and the European perspective .....	24
	Annex: Alignment of national policies with ERA pillars / objectives .....	28
	References .....	38
	List of Abbreviations .....	41

## 1 Introduction

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In 2010, Switzerland had a population of about 7.9m people corresponding to about 1.6% of the population in the EU-27. Its gross domestic product (GDP) amounted to about €440b, yielding a GDP per capita of about €56,000. Research intensity measured by gross domestic expenditures on R&D (GERD) was 3% of GDP in 2008 and 2009, which is substantially higher than the average in the EU-27 of about 2%. Therefore, Switzerland already reaches the 3% target. This high level of expenditures is largely due to the private sector, which already exceeds the 2% target for gross domestic expenditures on R&D financed from private sources (BERD). On the other hand, GERD financed by the State amounted to 0.68% of GDP in 2009 which is just above the EU-27 average and well below the 1% target. GERD financed by abroad amounts to 0.18% of GDP. The higher education sector accounts for nearly all of the public R&D expenditures, which in turn correspond to about 25% of GERD. In contrast, the private sector accounts for almost 75% of GERD. The rather low level of public R&D expenditures has to be judged more favourably than at first glance, exactly because Switzerland does not support private research directly. Instead, these expenditures are focused on basic and long-term research in universities, which on the whole enjoy a very good funding level in comparison with other European countries. The higher education system consists of ten cantonal universities, two Federal Institutes of Technology and nine Universities of Applied Sciences (7 public and 2 private). Public research institutes are relatively unimportant. The most important are the four research institutes of the ETH domain. High private R&D expenditures are an outcome of the specific structure of the Swiss economy. The private sector is dominated by two sectors, pharmacy and the machine industry where about two thirds of BERD are concentrated. Both are characterised by the presence of large multinational companies with headquarters in Switzerland. The bulk of BERD within these sectors is conducted by a small number of multinational companies. Given the size of these companies and their global strategies, this implies that the Swiss State has little influence on private research, except in providing good framework conditions to the research activities of these multinational companies. Hence, research policy focuses on maintaining the quality of the public research sector and the training of skilled researchers.

The Swiss research system is of very good quality both concerning scientific and technological outputs, as shown by international indicators concerning scientific production (publications and impact factors) and technological production (patents). It shows a distinct organisation, based on a clear-cut separation between the public sector, centred on very research-intensive universities, and the private sector, centred on the large research units of multinational companies. The cooperation between the public and the private sector in common innovation projects is based on bilateral contacts at the level of research units and its promotion represents a central goal of the Swiss Innovation Promotion Agency (CTI). Moreover, universities train large numbers of PhD students, which then to a large extent continue their career in private companies, thus providing them with a large reservoir of skilled researchers.

With regard to innovation output, Switzerland is seen as an innovation leader outperforming all EU member states. Generally, Switzerland's main strengths are considered to be in open and excellent research systems, intellectual assets, innovators and outputs. Relative weaknesses can be found in finance and support, linkages and entrepreneurship (European Commission, 2011a). Switzerland belongs to the top of the



group of European innovation leaders together with Denmark, Finland, Germany, and Sweden.

Figure 1 shows a map of the most important organisations with respect to research policy (for a more complete overview of the Swiss system refer to Braun & Leresche, 2007; Arvanitis et al., 2010; Lepori, 2007b).

### Main actors and institutions in research governance

Political responsibilities for research and higher education are divided between the central state (Confederation) (represented by the main box in the centre of the diagram) and the regional authorities (the Cantons) (the far left box on the diagram). The Confederation is responsible for direct funding of research and for the coordination of research activities, while the responsibility for higher education is shared between Confederation and Cantons as follows: The Confederation is responsible for the two Federal Institutes of Technology (ETH) in Zurich (ETHZ) and in Lausanne (EPFL). The Cantons are responsible for their universities, while a national act is regulating federal support to these institutions. The Universities of Applied Sciences (UAS) are ruled by the Cantons, but under the framework of national law, which includes financial support by the Confederation.

At the federal level, responsibilities in respect to research and higher education are divided between the Federal Department of Internal Affairs and the Federal Department of Economic Affairs. Other departments play a very restricted role, mainly through departmental research. An exception is research in the energy field carried out by the Swiss Federal Office of Energy.

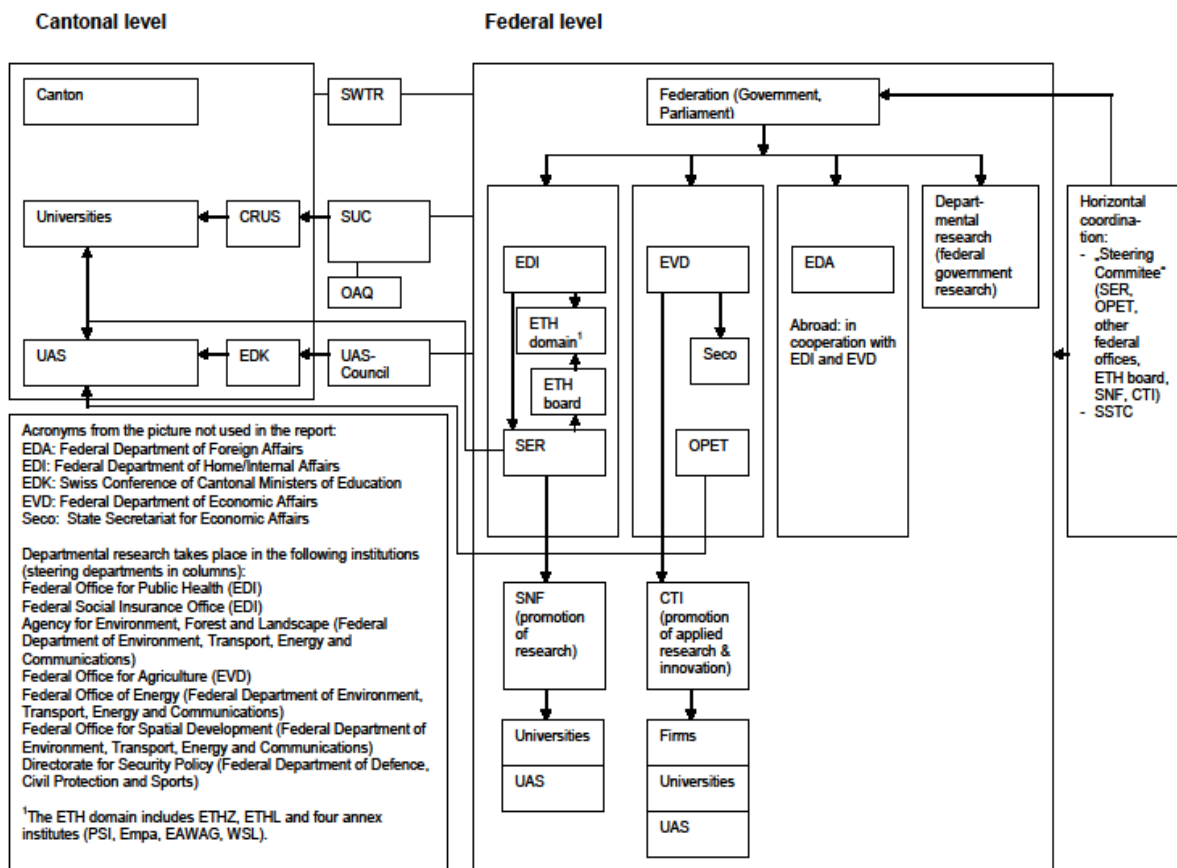
Inside the Federal Department of Internal Affairs (the left box inside the box for the federal level), the most important organisational unit is the State Secretariat for Education and Research ([SER](#)). It coordinates the whole domain together with the Federal Office for Professional Education and Technology ([OPET](#)), including the preparation and elaboration of the four-year strategic plans to the parliament (Federal Council, 2007), support to cantonal universities, funding of basic research through the Swiss National Science Foundation ([SNF](#)) and international activities of Switzerland. Located in the same department, the [ETH Board](#) steers the ETH domain, which includes the two ETHs and four annex institutes, namely the Paul Scherrer Institute (PSI), the “Swiss Federal Institute of Aquatic Science and Technology” (EAWAG), the “Swiss Federal Laboratories for Materials Science” (EMPA), and the “Swiss Federal Institute for Forest, Snow and Landscape Research” (WSL).

Inside the Federal Department of Economic Affairs (the box to the right of the box for the Federal Department of Internal Affairs), the OPET is responsible for professional education, and the coordination and funding of the UAS. The Swiss University Conference ([SUC](#)) (located between the cantonal and federal level in the diagram) is a common body of Cantons and Confederation in charge of the coordination of the university domain (ETH and cantonal universities). The Conference of Rectors of Swiss Universities ([CRUS](#)) is a private association composed by the rectors of the cantonal universities and by the presidents of the two ETHs. The CRUS is in charge of the preparation of the university planning on behalf of the SUC and manages a number of coordination programmes and activities between Swiss universities. A parallel body exists for UASs, called the Swiss Conference of Rectors of Universities of Applied Sciences (UAS-Council).

At the intermediary level, the main actors are the two project funding agencies and an advisory body: The SNF is a private foundation funded by the Confederation that is responsible for the support to basic research (in the diagram, it is located below the SER because the SNF is headed by the SER). Moreover, it manages the national research

programmes (NRP), as well as a programme aiming to create “National Centers of Competence in Research” (NCCR) at the national level. The Swiss Innovation Promotion Agency (CTI) is the federal support agency for innovation, which supports joint projects between universities and private companies as well as innovation activities. Until 2011, it was situated within the OPET (below the OPET in the diagram. Now, the CTI is an independent decision-making body within the Federal Administration that reports directly to the Federal Department of Economic Affairs. The Swiss Science and Technology Council (SSTC, at the far right in the diagram) is the advisory body of the national government for science and technology policy. The budget of the OPET amounts to €994m, where the bulk is spent for vocational training and UAS and only about 1.4% are spent for research and innovation (the CTI’s budget is independent from this figure). The SER’s budget amounts to about €6,500m between 2008 and 2011. The SNF, cantonal universities and international research cooperation and programmes each receive about one third of the budget.

**Figure 1: Overview of Switzerland’s research system governance structure**



Source: [ERAWATCH Research Inventory](#) (modified)

### The institutional role of regions in research governance

Due to the federal organisation of the country, Cantons are very important actors in Swiss research and higher education policy. Cantons have full sovereignty over their own universities, while the Confederation has the right of managing the two ETHs, as well as supporting cantonal universities. Competences for UASs are shared between the Cantons and the Confederation.

Cantons are also relevant actors in all policy debates on research and higher education policy, for instance, negotiations on research plans. Finally, Cantons are in charge of

economic promotion, though most general Cantons do not pursue an explicit innovation-oriented policy (TrendChart, 2009).

## 2 Structural challenges faced by the national system

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Switzerland is a small-size European country with a level of economic development among the highest in Europe. Its economy is among the most open worldwide and displays a strong specialisation in a restricted number of technologically-intensive sectors, including the pharmaceutical, chemical, food, machine and precision instruments industries. In these sectors, Switzerland is the seat of some of the largest multinational companies worldwide, including Novartis, Roche, Nestlé and ABB. Although Switzerland shows a strong specialisation in banking and finance within the tertiary sector, Switzerland does not have a significantly high share of employees in the tertiary sector compared to other European countries.

Following other ERAWATCH country reports from previous years, the main structural challenges can be defined according to needs that have to be fulfilled by the research and innovation system and its policies, namely resource mobilisation, meeting knowledge demand, knowledge production, and knowledge circulation.

### **Resource mobilisation**

Private R&D is strongly concentrated in a few core sectors – chemicals, pharmaceutical, machine industry – which corresponds very well to the technological specialisation of the Swiss export industry – as well as in a few Swiss multinational companies in these sectors. The State has little influence on private R&D and makes itself dependent on the fate and corporate strategies of these large companies, whose research expenditures exceeds in some cases the whole national research budget. In addition, there is limited influence of the State on private spending. Public expenditures are strongly concentrated on supporting basic as well as applied research in universities and are relatively small compared to private R&D expenditures.

Total higher education spending on R&D (HERD) accounts for 0.4% of GDP in the OECD area. Sweden has the highest research intensity in the higher education sector at 0.9% of GDP. Switzerland ranked on the sixth position in 2009 with HERD intensity well above the EU and OECD average (OECD, 2011a: 78).

With regard to resource mobilisation, Switzerland's main strengths are high levels of private research funding, a strong orientation of public funding towards basic and applied research, a very good provision of trained researchers with PhDs, and a highly efficient project funding system especially for basic research (through SNF).

However, the dependency on private-sector research and the relatively low level of public-sector expenditures can be considered a challenge. Public expenditures are strongly focused on supporting basic and applied research in universities. With worsened economic prospects and companies cutting their R&D budgets, Switzerland could lose its very good position in the level of R&D intensity because of a lack of funding. The state possesses few levers to influence the R&D strategies of large companies. In addition, these companies reflect rather conservative sectors.

### **Knowledge demand**

An important structural change of all economies in the EU is that they are becoming more and more knowledge-intensive. Switzerland had an above-average proportion of employees in knowledge intensive activities (42%) in 2009 (EU: 35%) which is one of the highest proportions of all European countries. Considering only business industries

and excluding the public sector, 20% of all employees in the business sector are engaged in knowledge intensive activities compared to 13% in the EU. In addition, it also displays higher annual growth rates of the proportion of employees in knowledge intensive activities compared to other European countries (European Commission, 2011b: 383). Switzerland still has a relatively large manufacturing sector in terms of the number of employees reflecting the economic structure of the country. Switzerland - as all industrialized countries - displays a negative growth rate of employment in manufacturing and a positive growth rate of employment in services indicating a gradual trend towards a services economy. However, in Switzerland there has been a comparably low decline in employment in the manufacturing sector (comparable to Germany) and a very low increase in employment in the services sector (see European Commission 2011b: 377-379). This fits well with the relatively high growth of GERD with an average annual growth rate of 4% between 2000 and 2009 because services sectors are generally less research-intensive, whereas HERD of the EU and the US has been growing by only 2.5% in the last decade (European Commission 2011b: 51). However, since the beginning of 2011 and especially since the Swiss Franc has increased in value, the risk of a creeping deindustrialisation is mentioned in public debate. The picture of a relatively small service sector also changes by considering only knowledge-intensive services. 43% of all employees worked in knowledge intensive services in Switzerland compared to 38% in the EU. In addition, 2.8% of all employees worked in high-tech manufacturing firms, which is one of the highest rates in Europe, compared to 1.1% in the EU. Most interestingly, Switzerland's economy displays a clear trend towards more employment in high-tech industries (with a growth rate of 2.6%), whereas other European countries have experienced strong declines in this rate (EU growth rate between 2008 and 2009 is -3.5%). In addition, there might be a substitution of employees in medium-high-tech sectors by employees in high-tech sectors because Switzerland experienced an above average decline in employment in medium-high-tech sectors (European Commission, 2011b: 386). Knowledge demand is characterised by a strong bottom-up approach and an extensive involvement of social and economic stakeholders in the design of research policy where decision on research direction and content is left to researchers and private companies. Hence, there are few policy instruments focusing on thematic priorities. While this model has proven to be very effective, it drives to a fragmentation of research policy and to a largely incremental practice in setting priorities and allocating financial means. The system is lacking a systematic mechanism to identify knowledge demands and, especially, to anticipate future challenges which would require new policy action. Stakeholders' consultation is largely reactive and related to the next planning phase. What is missing is a place where these demands can be articulated and compared with analysis of future challenges in order to develop a long-term strategy. Moreover, despite the rather large number of studies and evaluations commissioned by different federal bodies, there is a lack of systematic foresight of new trends in research and technology. This lack of strategic intelligence and of priority-setting could become a relevant weakness in case of rapid changes in the scientific, technological and economic environment with the risk of not assembling critical mass in an area.

### **Knowledge production**

The public research system of Switzerland is considered among the best in the world in terms of quality and impact of its scientific production. In all international rankings of higher education institutions a relatively high number of Swiss universities are on the forefront (Leiden Ranking, 2011; Shanghai Ranking 2011; THE, 2011). Switzerland holds the second rank in the relative publication and citation index (SER, 2011a).

Switzerland has the highest rate of high-quality publications among OECD countries. Publications from researchers located in Switzerland have the highest impact of international scientific collaboration on research output (OECD, 2011a: 94-95). Also, Switzerland had the largest graduation rate at doctoral level of all OECD countries reaching 3.4% in 2009. This figure is important because doctoral graduates are key players for research and innovation. The percentage of graduates in science and engineering is about 40% which is only slightly above the OECD average (OECD, 2011a: 68-89). In 2009, about 35% of the population between 25 and 64 years had a higher educational degree (EU21: 27%) (OECD, 2011b: 40).

Given these facts, the knowledge production by higher education institutions can be considered to be very good. Challenges might be the fragmentation of the higher educational system, the slow pace of reforms in this domain, and little influence of policies on knowledge production in the private sector. In addition, a major challenge is still the lack of skilled workers in spite of relatively high graduation rates.

### **Knowledge circulation**

Promotion of cooperation and technology transfer reflects a central element of the Swiss research and innovation policy. The SNF fosters cooperation among researchers by using it as an evaluation criterion. Furthermore, it provides instruments explicitly requiring cooperation, notably the interdisciplinary instruments NRP and NCCR. In addition, most of the CTI budget is devoted to projects in order to promote cooperative research between higher education institutions and private companies. The SNF also encourages cross-border knowledge circulation by facilitating mobility of researchers (ERAWATCH Network, 2010).

Traditionally, cooperation between public and private R&D-performers and transfer of research results have been left to the bilateral contacts between university institutes and companies with little intervention from the State. Policy intervention in this area has been mainly indirect and focused on SMEs through the creation of UAS as cooperation partners of SMEs and through joint public-private project funding by the CTI (ERAWATCH Network, 2009).

Interestingly, although promotion activities in the field of innovation mainly focus on enhancing cooperation and knowledge transfer between universities and firms, only about 40% of large firms are engaged in collaborations on innovation activities with other firms compared to 70-80% in other countries as Denmark, Finland, Belgium or Austria. Also, relatively few firms are engaged in international collaborations (OECD, 2011a:104 and 106).

The main strengths and weaknesses of the Swiss research system in terms of knowledge circulation can be summarized as follows: There is very good tradition of direct collaboration between research institutes in universities and private companies favoured by informal contacts and transfer of people. However, a systematic policy for knowledge circulation and support to absorptive capacity is lacking (ERAWATCH Network, 2009: 52-70). Policies have minimal impact on the bulk of Swiss private research and innovation budgets which are spent by multinational companies. In this area, there is a noteworthy lack of coordination between research policy (focusing on the quality of academic research and provision of skilled researchers) and economic promotion policy (focusing on market and localisation conditions) because of fragmentation of responsibilities both at the federal level and between Confederation and Cantons.

## 3 Assessment of the national innovation strategy

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### 3.1 National research and innovation priorities

The most important policy document is the Message on Support for Education, Research and Innovation from the Federal Council (Federal Council, 2007; 2010). With this message, the Federal Council asks the parliament for granting the necessary funds and presents federal goals and measures in the field of ERI. It is the key strategic plan indicating key objectives and measures for the next planning period, at the same time defining the financial means available. The strategic plan is prepared by the Federal Council after a broad consultation process of all potential stakeholders and passed by the parliament after a broad consultation process of all potential stakeholders in the course of the so-called "Vernehmlassungsverfahren". Although the ERI message tries to set own priorities, the priorities are not limited as all relevant institutions are addressed and hence all priorities that are relevant for these institutions are tackled. Generally, all expertise that is available to assess strengths and weaknesses is used as an input. In addition, the consultation process and the bottom-up principle of not providing thematic steering guarantees that different stakeholder opinion from national and regional level and all relevant business sectors are included.

Generally, the Federal Council sets up such messages for four years. For 2012, there is an exception with a one-year message mainly continuing goals and measures from the message 2008-2011. The reason is a change in the Federal Council's schedule in providing messages to the parliament to reach a better coordination between the financial messages and the planning of the legislation. After the transitional message for 2012, there will be again four-year messages. Generally, research and innovation policy is characterised by a high degree of continuity. There have not been any major changes in the orientation or in the priorities set by the federal government. The Swiss research and innovation policy with respect to private firms is almost exclusively focused on SMEs and their cooperation with HEIs. The most important priority is to create favourable conditions for firms. This includes a strong focus on knowledge transfer, but almost no direct policy support measures. Emerging topics arising from societal challenges and enabling technologies are addressed in the ERI message, but they must be mainly dealt with within existing policy measures. Therefore, there is no selection of specific topics. There have not been any systematic evaluations of research and innovation policy in recent years besides internal reports (also including external expertise) conducted by OPET, SER, and the ETH board. There are also a number of evaluations in much specialised sub-areas of support activities that are summarised in the ERI messages.

In 2010, the Federal Council defined the following priorities in order to put its vision into force: Strengthening and enlargement of international interconnectedness; support of educational export and import of talents; support of international recognition. Given the Swiss tradition of no direct intervention of the State in private R&D activities, only a few promotion instruments exist and the strategic routes of stimulating greater R&D investment in R&D performing firms, stimulating firms that do not perform R&D yet and attracting R&D performing firms from abroad has a limited importance for Swiss research and innovation policy. On the contrary, promoting the establishment of new R&D performing firms and cooperation between HEIs and private companies are very important in the Swiss context.

An explicit goal of the CTI is to open up to new potential applicants, especially firms that have not cooperated with universities yet. It is intended to support R&D projects from

non-technological subjects, for instance from services, health, or social work and arts, as well as risky R&D projects. The CTI also strives to enable their clients to get access to international R&D and innovation networks. The Federal Council wants the CTI to become more customer-friendly, for example by working on demands for funds more efficiently and constructively. CTI shall support all steps of innovation projects in order to improve the quality of the projects. The CTI has experienced an enormous growth in applications from 444 in 2008 to 780 in 2010; the promotion of start-ups has also grown strongly.

In 2009, the Federal Law on the Promotion of Research and Innovation (FIFG) was revised in order to introduce the CTI into the FIFG (put into force in 2011). The CTI has become independent and has been granted extensive decision competencies over its promotion activities, in knowledge and technology transfer, and in development of instruments to support start-ups. The CTI has been re-organized and is now an independent agency and headed by an executive committee. Moreover, the CTI's mandate and tasks are now defined in the FIFG rather than in the employment legislation as before. The reform of the legal status of the CTI has increased the independence and autonomy of the innovation promotion agency and shows the importance of knowledge transfer and of enabling small firms to cooperate with HEIs. In 2011, the parliament decided on a so-called "Frankenpaket" comprising an additional temporary fund for innovation promotion via the CTI in order to mitigate economic problems arising due to the strong Swiss franc. As a consequence of this programme, federal funding to CTI has been doubled from €80m in 2010 to €160m in 2011. The CTI has been enabled to grant support in the amount of more than 50% of project costs within the framework of this program although firms have had to carry a minimum of 50% according to the hitherto existing rules. The program shows a very pragmatic approach in support of the export industry and the high priority of innovation promotion (in spite of the very small scope of promotion measures in Switzerland). An interesting point is the relaxation of conditions for funding which has raised fears of violating Swiss principles over the spending of public funds and supporting low-quality projects. These fears are typical for Swiss policies and a good example why innovation promotion is strictly competitive and limited.

In a country where almost all public research is performed in HEIs, it is obvious that higher education policies are highly relevant for public research. With respect to the ETH domain, the 2008-2011 message defines nine goals which will be still pursued in 2012: First-class teaching, top position in international research, cooperation with the industry, bilateral international cooperation, attractive and family-friendly working conditions, gender equality, cooperation with other universities, performance-oriented allocation of funds, recognition in society and enforcement of dialogue with society. Regarding the ten cantonal universities, it is planned to improve the number of students relative to the number of scientific staff and the education on doctoral level. Reforms will be accompanied by a Swiss-wide monitoring.

The SNF fulfils an important role with respect to ensuring the top position of Swiss basic research in cooperation with HEIs. The main goal with respect to the SNF is to increase support by funds that are distributed competitively because there has been an enormous increase in demand for funds. A relevant change in the recent past has been that SNF grants entail an overhead to cover general costs of the hosting institution paid to the institution directly. The amount increases over time. It was about 6% of grant funding in 2009 and about 10% in 2010. This measure has a highly political relevance, since it is a first step towards the direct financing of general costs of research, separated from the universities' core budget.

The Federal Council considers a stronger use of basic research for promotion of innovation and a stronger coordination between SNF, CTI and the private sector as well as support of cooperation between different research groups as important. Applied research in order to solve problems in society and economy is of growing importance to the SNF. It established the NFP for this purpose where researchers work together with research groups from industry. The NFP aims for applying knowledge and contribute to acceptance and understanding of usability of scientific results. With regard to the NCCP, a major goal is innovation support by using economic potentials in cooperation with the private sector or by the CTI. It is an important goal of Swiss Federal research policy to improve cooperation between SNF and CTI. It shall be evaluated whether projects that are based on basic research as well as on applied research might be jointly funded. In addition, NCCR and NPR shall be linked. In sum, there is the attempt to relate basic research and applied research activities and to increase R&D both in the public sector (through HEIs) and in cooperation with the public sector.

Currently, the FIFG is under revision. Most importantly, it is planned to support a national "Innovation Park". Remarkably, this is a direct allocation of reserves which is untypical for Switzerland's innovation policy. However, support is limited to dispensing real estates by the Confederation. The new institution shall enable cooperation between firms and universities and is therefore in line with existing innovation promotion. More specifically, firms and universities are enabled to use real estates in the park in order to set up research laboratories. Under the new Federal Act, the SNF will be enabled to support international programs. Furthermore, competencies of different institutions will be defined more clearly, coordination will be improved regarding departmental research ("Ressortforschung") and the SSTC will be designed a narrower set of tasks with a focus on evaluation.

In 2013, education and research will be brought together into one department. Currently, the tasks of the Federal Department of Internal Affairs comprise the ETH domain and basic research, whereas applied research is under the domain of the Federal Department of Economic Affairs. The goal is to minimize frictions and to simplify coordination between both activities, promotion of basic and applied research. In addressing the challenge, outlined in Chapter 2, that Switzerland's research policy mainly focuses on basic research in universities and that it is dependent from large companies' R&D expenditures, there will be little change in spite of considerable increases in the available budgets. This could be a problem when facing economic difficulties.

In another field, the coordination between research and innovation policy, there are statements of intention to improve the situation. However, the strategic plan is currently lacking a concrete plan of action. Therefore, in spite of remarkable efforts in the right direction, it is questionable whether the goal can be fulfilled.

The strategic plans for 2008-2011 and 2012 do not include any measures in order to envisage problems of skills shortage especially in natural sciences and engineering although it acknowledges the urgency of this topic. Also, the issue of fragmentation of responsibilities and the lacking thematic steering will remain unaddressed reflecting the general orientation of the Swiss ERI policies. To sum up, policy changes are rare and almost all activities are in place to fulfil the priority of creating framework conditions and of enhancing cooperation between HEIs and private firms. Little deviations from the principles of refraining from direct funding and competition are mostly due to pragmatic considerations but do not change the main orientation of Swiss policies.



### 3.2 Trends in R&D funding

Swiss research policy is characterised by continuity and stability of its main orientation, as well as of budgetary planning. The Federal Council aims for a growth rate of expenditures for education, research and innovation of 4.5% per year. Between 2008 and 2011 expenditures grew by 6% annually. GERD as a share of GDP increased from 2.9% in 2004 to 3% in 2008. The lack of instruments to directly support private R&D is a relevant characteristic of Swiss research funding. With about 1% of BERD funded by the State Switzerland has by far the lowest share among OECD countries.

An important trend in public R&D expenditures is the increasing R&D expenditures for universities. Private R&D expenditures also have increased tremendously, but do not account for a higher proportion of GERD than in 2000 because R&D expenditures in universities have been increased on a higher level. In contrast to other countries, Switzerland has very low expenditures for R&D on federal level to support R&D different from support to universities and the proportion on GERD is further declining. HERD amounted to €3,152m in 2008 after €2,400m in 2004, BERD to €9,584m in 2008 after €7,728m in 2004, and GBOARD to €96m in 2008 after €112m in 2004. Whereas in Switzerland only 0.75% of GERD is carried out by the State directly, this proportion amounts to about 13% in EU-27 in 2008. Although BERD as percentage of GERD is much higher in Switzerland (73.5%) compared to EU-27 (62.5%), HERD as a percentage of GDP is approximately on the same level (CH: 24.2%, EU-27: 23.4% in 2008)<sup>1</sup> (FSO, 2010b).

Public spending for the ETH domain will be €1,731m in 2012 after €1,702m in 2011 that is lower as demanded by the ETH council that asked for €1,849m (ERI message, 2012: 777). In recent years, there have been always increases in the ETHs' budget, but only at a level of about 3% per year.

The SUC asked for funds of €592m in 2012 for cantonal universities. However, the Federal Council only plans to grant funds of €562m. Increases in budget in this domain have occurred at an even lower level than in the ETH domain. At the same time, the share of third-party funding of universities increased from 20% in 2000 to 22% in 2008 resp. 23% in 2010 (FSO, 2010a), thus reflecting limited financial scope of federal budgets.

Grants to the SNF were initially scheduled to be increased by 7.5% per annum. However, the budget was about €655m in 2011 and will be raised to €674m in 2012 which is a growth rate well below the target and considerably lower than in previous years.

Grants to the CTI have increased slightly from €94m in 2011 to €97m in 2012. CTI itself estimated their budget requirements for 2012 at a much higher level at €120m. On the whole, the strategic plan for 2012 foresees to freeze public investments in 2012 to the originally planned level of 2011. For the planning period 2013-2016, a further increase of 3.7% per annum is foreseen. It is planned to slow down the growth slightly because of lower economic growth prospects. Some slight cuts were already decided for 2011 owing to financial problems of the public budgets (Federal Council, 2010). However, the economic stabilisation programmes initiated due to the financial crisis yielded about €32m of additional spending for supporting research and innovation.

Overall, promotion of research and innovative activities is of high political priority and resource provision seems to be relatively good. However, the planned increases in budget are rather incremental in scope. There have not been any remarkable impacts of the financial crisis on R&D expenditures. However, upcoming economic problems are

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<sup>1</sup> Note that financial figures on R&D spending are only available every three years. Data for 2011 is not available at the time of writing. We have used data from 2008.

likely to have a negative impact on the R&D expenditures of the private sector. Generally, a high priority is attributed to competitive and collaborative funding of research. To be more concrete, almost all funds targeted at individual persons or private firms are distributed competitively. In the area of promotion of innovation, almost all instruments are focused on collaborative funding. Subsidies and tax incentives are not in line with the principles of Swiss research and innovation policies and do not play a role (taxes are rather low, in general). The balance of the share of the main funding mechanisms with respect to competitive vs. institutional funding has not changed in the last three years. Also, there has not been a change in the share provided by different funding sources except for the ETHs that are currently looking for sources to increase their third stream funds.

**Table 1: Basic indicators for R&D investments in Switzerland**

	2008	2009	2010	EU average 2010
<b>GDP growth rate</b>	2.1	-1.9	2.7	2,0
<b>GERD as % of GDP</b>	3	3	N/A	2.0
<b>GERD per capita</b>	1,352	N/A	N/A	490.2
<b>GBAORD (€ million)</b>	2,604,9	N/A	N/A	92,729.05
<b>GBAORD as % of GDP</b>	0.76	N/A	N/A	0.76
<b>BERD (€ million)</b>	7,546,9	N/A	N/A	151,125.56
<b>BERD as % of GDP</b>	2.2	N/A	N/A	1.23
<b>GERD financed by abroad as % of total GERD</b>	0.18	N/A	N/A	N/A <sup>2</sup>
<b>R&amp;D performed by HEIs (% of GERD)</b>	24.2	N/A	N/A	24.2
<b>R&amp;D performed by PROs (% of GERD)</b>	0.75	N/A	N/A	13.2
<b>R&amp;D performed by Business Enterprise sector (as % of GERD)</b>	73.5	N/A	N/A	61.5

Generally, there is no thematic focus of the R&D budgets reflecting the bottom-up principle in Swiss research and innovation policy. An exception is cooperation in aerospace in Europe. In addition, the Federation supports departmental research in order to support departments on federal level. Currently, the following policy areas are supported (budgetary allocations in parentheses: Health (€10m), social security (€1m), environment (€8m), agriculture (€54m), energy (€22m), mobility (€2m), development and cooperation (€40m), security policy (€25m), vocational training (€4m), sports (€1.4m), sustainable traffic (€6m). As already mentioned, research at the federal level, accounts for a very small share of total R&D spending.

A considerable part of funding is dedicated to public-private partnerships and knowledge transfer. For example, NRPs and NCCRs account for 11% of the SNF's budget. The CTI's budget is almost exclusively focused on these purposes although its overall budget is still small compared to the SNF's budget.

The strongest budget increase for the period 2008-2011 has been planned for bilateral and multilateral cooperation reflecting its importance for Switzerland. The annual growth rate amounts to about 15%. For 2012, the majority of the budgets in this domain will be sustained at the same level as in 2011 or will be slightly cut. The cuts in budgets mainly reflect efforts of consolidation and prioritisation, but there is the attempt to further strengthen multilateral cooperation in R&D and innovation.

Swiss participation in the European Framework Program yields about €160m for research per year and the budget is increasing from year to year. Switzerland benefits from a positive net injection of funds from the ERP. For example, Swiss research received funds of €636m during the 6<sup>th</sup> ERP, whereas the Swiss contribution amounts to €620m. The 2012 message allows for additional funds of €8.6m for 2012, amongst others because of the relatively good development in the Swiss GDP during the last financial crisis and the resulting higher membership fees. However, current estimates for 2012 might not hold because of lower growth prospects for Switzerland and the uncertainty with respect to exchange rates.

<sup>2</sup> 8.4 (2009), 9.04 (2005)

### **3.3 Evolution and analysis of the policy mixes**

A well performing national and regional research and innovation system should be able to enhance competitiveness and job creation and to address major societal challenges such as resource efficiency, climate change, and health and ageing. It should be designed in a strategic, coherent and integrated framework geared towards fostering innovation and strengthening the knowledge base and fundamental research. The Swiss research and innovation policy is clearly focused towards strengthening the knowledge base and fundamental research. Innovation is fostered by knowledge transfer and public-private cooperation although direct funding mechanisms for firms are mostly non-existent. Obviously, the federal authorities are aware of all major societal challenges. They are addressed in the main policy documents and there are a lot of external evaluations outlining these challenges. However, as outlined above, strategic intelligence to come up against these challenges with concrete measures is lacking. In addition, the policy mix is oriented towards generic support rather than development of specific research topics, including main social challenges (an exception is the planned “Action Plan for Integrated Energy Research in Switzerland” (SER, 2011b).

The design and implementation of Swiss research and innovation policies is steered at the highest political level and based on multi-annual strategies as can be seen from the messages. Although Switzerland is not a member of the EU, Swiss politicians are well aware of the opportunities and strengths of R&D cooperation within an EU context. The political system of Switzerland ensures that all relevant stakeholders are included in decision-making. Although Swiss policy documents reflect emerging opportunities, they mainly emphasize strengths of Swiss research and innovation policy and its outcomes without analysing weaknesses in depth. An effective monitoring and review system is not in place.

The scope of innovation policy mainly comprises technological innovations and not so much innovation in services and improvements in processes reflecting the orientation of Swiss economy. Switzerland tries to help spur innovation nearly exclusively through supply-side instruments. Scientists define projects with industry participation while the concept of valorisation of knowledge leads to the creation of transfer centres and networks of transfer institutions. There is generally no support for mobilising demand for R&D and related services, specifically in small firms.

Public investment in research and innovation can be considered predictable and stable although there are only incremental increases in related budgets. The amount of public budget is also established in the four-year ERI messages to ensure predictability and long-term impact. It is ensured that private sector firms receiving public funds have to increase their own R&D expenditures, therefore leveraging greater private sector investments.

Excellence, high quality and competition are important criteria for the allocation of funds. Projects are generally selected according to the quality of proposals which is in line with the bottom-up principle. Universities enjoy a relatively high degree of autonomy. Employment conditions for researchers are very good in terms of salaries and provide incentives to attract international talent which is reflected in a high proportion of foreign PhD students, Post-Docs, and professors. The Swiss research and innovation system can be considered very open.

Partnerships between higher education institutes, research centres and businesses are actively promoted. Policies and instruments such as knowledge transfer platforms, and voucher systems are in place to encourage cooperation and knowledge sharing and to create a more favourable business environment for SMEs.

Legal framework conditions can be generally considered as being supportive in promoting business investment in R&D and innovation. Switzerland offers a reliable legal framework including an appropriate system for the protection of intellectual property, favourable taxation, and a highly developed financial system.

Public support to research and innovation in businesses is simple, easy to access, and of high quality. There are output-oriented funding instruments available which are especially focused on the needs of SMEs. Access to funding instruments is generally unbureaucratic. Funding schemes are regularly evaluated although not always in international comparisons.

The Swiss public sector does not provide incentives to stimulate innovation within its organisations and in the delivery of public services although public resorts do some internal research. Therefore, the public sector cannot be considered to be a driver of innovation itself.

A major threat may be the insufficient supply with graduates in science, technology, engineering and mathematics. In addition, education and training curricula show deficits with respect to the training of intercultural and communication skills as well as to entrepreneurial education.

The lack of entrepreneurial spirit is a major weakness of the Swiss innovation system as it is indicated by measures such as the availability of early-stage venture capital. Further barriers to entrepreneurship include regulatory burdens and opacity. Public support for entrepreneurship is however provided through CTI's start-up funding programme plus a mobilisation initiative called Venturelab. Together, the bankruptcy law and the high cost of equity financing slow the growth of small and new firms (OECD, 2006, p. 101).

In sum, there have not been any major changes in the policy mix as Switzerland's policies can be generally described by a high level of stability and continuity. The 2012 message governing Swiss innovation policy does not set new priorities compared with former messages. The only important trend that has been arisen is a shift towards internationalisation, e.g. by taking part in Europe-wide R&D collaborations. It can be expected that this trend will be continue further on. The general direction of the Swiss research and innovation policy is to provide favourable framework conditions. Hence, priorities are to foster basic research and technology transfer. Furthermore, the government fosters start-ups by providing advisory and network services. Most policies are implemented in a bottom-up approach, i.e. have no predefined priority area.

### **3.4 Assessment of the policy mix**

The implementation of the four-year plans generally follows a bottom-up strategy, that is, governmental funding is granted as either block grants or distributed in a peer-reviewed evaluation process. Hence, Swiss policy provides little thematic steering, but focuses on providing favourable framework conditions for research and innovation.

Although Switzerland has a very good position with respect to the number of publications per 1,000 inhabitants, the total number of publications is small and the growth is limited. Switzerland is dependent on foreign countries in a number of ways: A large number of researchers in Switzerland are from abroad. Knowledge is created in international networks today and costs must be shared. Research is a domain in which globalisation is most advanced. Therefore, policy actions in order to improve international cooperation are essential for Switzerland.

Promoting the establishment of new R&D performing firms, especially of university start-ups, has been a clear focus in the most recent years. Most initiatives have been promoted by regional actors together with the universities themselves: among the most

active have been the EPFL, which hosts a science park, as well as the UAS. Science and technology parks have been created in about 20 Swiss cities, mostly in cooperation with higher education institutions (<http://www.swissparks.ch>). They offer favourable locations, coaching and support to start-ups. At national level, the CTI supports the creation of innovative start-ups through its [CTI start-up programme](#), while training in entrepreneurship is provided through the national [Venturelab programme](#). These initiatives have some relevance to promote the creation of innovative start-ups, but in the aggregate the impact on private R&D activities is likely to be very limited (TrendChart, 2009).

Promotion of cooperative research between higher education institutions and private companies is the main route of direct support from the State to technological innovation, especially in companies without their own research capacity. Most of the budget of the CTI (about €94m) is devoted to these projects. This approach has been confirmed also in the economic support programme approved by the government in spring 2009, where an additional €12m have been provided for the CTI, with a focus on renewable energies and smart materials. These measures target essentially SMEs.

The volume and the efficiency of R&D activities in the public sector is a priority of Swiss research policy. As usual in the Swiss context, this does not take the form of new investment plans, but of a gradual increase of resources and shifts in priorities. This route is meant to have an indirect impact on private R&D activities: namely, given the sector composition of these activities, it is assumed that multinational companies tend to locate their laboratories near to very good research centres and are influenced by the availability of well-trained researchers having obtained their PhD in universities.

While the support of R&D in private firms remains limited and focused on the facilitation of cooperation between public and private sector, it is organised with SMEs in mind. Hence, the organisation of support measures displays a simple structure, provides guidance and uses relatively few resources. However, no institutionalised evaluation programmes exist. Since 2009, the federal procurement process explicitly names fostering SMEs and promoting innovativeness as a goal.

Cantons attempt to create favourable framework conditions to new companies and multinational companies. This might include for example simplification of administrative procedures and investment in infrastructure. In their economic promotion policy, most Cantons provide this type of measure and there is a clear trend to favour innovative companies against more traditional activities.

The function of promoting research in specific technological domains has been largely delegated to European framework programmes, whose importance has strongly increased in the Swiss context. Framework programmes are the second most important project funding instrument in Switzerland after SNF grants. Furthermore, the weight of other European agencies, like the European Space Agency and Euratom have increased as well (SER, 2008).

Support to private companies has been explicitly targeted only towards small and medium enterprises (SME) and focuses on the promotion of technology transfer. The CTI funds the costs of public research partners in innovation projects that entail both private and public partners. The private partners have to provide at least half of the project costs. Hence, the private partners are not directly funded by the CTI. This mechanism has proven to be very effective in answering to the private companies' needs and evaluation studies have shown that CTI funded firms show a significantly better innovation performance than comparable firms without CTI support (Arvanitis et al., 2005). While the CTI budget has been strongly increased since the end of 1990 in parallel with the creation of the UAS, its magnitude remains relatively small.

Regarding private R&D investments, barriers are essentially related to the structural organisation of the Swiss economy and the dominance of large multinational companies in the high tech sectors. In the context of an extremely open economy with traditionally low levels of State intervention in private economy, public research policy has limited leeway to trigger changes.

Because public R&D expenditures are solely provided for basic and applied research, Switzerland runs the risk of revoking the breeding ground for following activities of R&D and innovation.

A general problem is that policy is well aware of challenges but that policy actions are rather indefinite. The reason may lie in dispersed political responsibilities so that it is not easy for political authorities on federal level to put concrete measures into force.

**Table 2: Assessment of policies addressing structural challenges**

Challenges	Policy measures/actions <sup>3</sup>	Assessment in terms of appropriateness, efficiency and effectiveness
<p><b>Dependency on private-sector research and relatively low level of public-sector expenditures;</b></p> <p><b>little influence on knowledge production in private sector</b></p>	<p>NRPs, NCCRs</p>	<p>The focus of policy actions on basic research reflects the general tradition of Swiss research policy. The division of tasks between the private and public sector has been proved efficient and effective. Future assessments will however depend on economic well-being of large multinational companies.</p> <p>Programmes such as NRP and NCCR are only of minor significance given the rather low budgets. However, they are well-functioning measures in order to improve cooperation between research in universities and in the private sector.</p>
<p><b>Lacking mechanism to identify knowledge demands and fragmentation of research policy</b></p>	<p>The ERI message considers improved monitoring of the education, research and innovation domain as a key priority in order to improve steering capabilities.</p>	<p>The monitoring is rather important in order to avoid excessive and unnecessary spending. It only has little significance for defining knowledge demands. Knowledge demand is still defined in a bottom-up approach which can be assessed as being an efficient and effective approach although it might take too long to define priorities in this way.</p>
<p><b>International competitive pressure (EU Lisbon targets, new EU member states and China and India investing heavily in R&amp;D)</b></p>	<p>Additional funding of bilateral cooperation between Switzerland and countries outside Europe; participation in EU programmes where funding is distributed competitively</p>	<p>Switzerland already has a strong position in international research programmes and also tries to install relationships with important countries in Asia and Latin America. Funding is in line with national principles, the programmes are well selected and policies are sophisticated in this area.</p>

<sup>3</sup> Changes in the legislation and other initiatives not necessarily related with funding are also included.

Challenges	Policy measures/actions <sup>3</sup>	Assessment in terms of appropriateness, efficiency and effectiveness
<b>Lack of skilled workers</b>	Support of applied R&D in UAS; improved cooperation between SNF and HEIs in promoting young researchers; improved cooperation between SNF, CTI and private sector businesses; the initiative of the skilled employee (Fachkräfteinitiative) launched in 2011 ( <a href="http://www.bbt.admin.ch/aktuell/medien/00483/00594/index.html?lang=de&amp;msg-id=41055">http://www.bbt.admin.ch/aktuell/medien/00483/00594/index.html?lang=de&amp;msg-id=41055</a> )	There are no concrete actions going beyond statements of intentions, probably because Switzerland still can satisfy its demand with immigration of skilled workers.
<b>Strong increase in the number of students; quality of education is not ensured</b>	The Swiss Center of Accreditation and Quality Assurance in Higher Education (OAQ) prepared guidelines for quality management	Problematic issues with respect to education at universities are acknowledged and goals are formulated, e.g., increasing the number of professors; however, increases in budgets are incremental and concrete measures are not formulated nor implemented.
<b>Fragmentation of higher educational system and slow pace of reforms</b>	The Federation and the Cantons define joint institutions and goals in order to jointly steer higher education	The new act which is foreseen in this domain will not suffice in order to remove fragmentation issues because it does not affect principal competencies and responsibilities or financing. However, it will help improving research evaluation at the university level.
<b>Lacking coordination between research policy, economic promotion policy and innovation policy</b>	Improved cooperation between SNF, CTI and private sector businesses; NRPs; NCCRs	Because SNF and CTI follow similar principles in selecting targets for funding, cooperation might be fruitful. There are already joint meetings. However, there are no concrete actions such as joint evaluations of applications going beyond basic forms of cooperation and statements of intention.

## 4 National policy and the European perspective

The ERA pillars comprise the following objectives:

- Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers
- Facilitate cross-border cooperation, enhance merit-based competition and increase European coordination and integration of research funding
- Develop world-class research infrastructures and ensure access to them
- Strengthen research institutions



- Facilitate partnerships and productive interactions between research institutions and the private sector
- Enhance knowledge circulation across Europe and beyond
- Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world.

With respect to the labour market, Switzerland still experiences a lack of skilled workers, especially in sciences and engineering. As a consequence, inward flows of researchers are important for Switzerland and the Swiss labour market for researchers is very open offering attractive employment conditions. Generally, international cooperation is very important for researchers and is actively promoted by Swiss research institutions. The SNF tries to enhance international cooperation by closing own multilateral contracts with other research councils abroad. There are already some world class research infrastructures within the ETH domain and they have become a focus of further activities in this field. Partnerships between HEIs and private firms are the major goal of Swiss innovation promotion and almost all measures are addressed towards enabling cooperation and knowledge transfer. Knowledge circulation across borders is also emphasised by various SNF activities. Switzerland participates in European research programmes and has tried to intensify cooperation with upcoming key countries in worldwide research.

Swiss immigration policy already ensures that demand for human resources for research is more or less satisfied although there are temporary scarcities and demand can by no means be satisfied solely with domestic employees. An important challenge remains the qualification of domestic employees.

Switzerland has a rather good tradition of participating in international programmes at the European level. It participates in the Cooperation in Science and Technology in Europe (COST), where the State Secretariat for Education and Research provides additional funding for research in COST actions with Swiss participation. It further participates in the European technology initiative EUREKA, where Swiss participations are funded through the CTI. Switzerland also supports a number of inter-governmental research infrastructures, namely ESA, CERN, ESRF, EMB, ESO, ILL, CIESM and HFSP. Switzerland also participates in the European framework programmes, where Swiss researches have been quite successful in obtaining funds, and in a number of projects of the European Science Foundation (ESF) beside of contributing to the general budget. As a general evaluation, Swiss participation in international programmes and opening of national programmes reflects the decentralised nature of Swiss research policy and the lack of planning in respect to research topics. Thus, research funding organisations are generally willing to participate and their funding situation allows finding resources for these activities. The funding situation of Swiss partners in ESF initiatives, COST and Eureka is generally more favourable than in the other European countries.

Switzerland reached an agreement with Germany (DFG) and Austria (FWF) concerning joint financing of bilateral or trilateral projects, where submission and evaluation takes place in one of the three countries, while funding is on national basis (lead agency procedures) or from the country where most of the research is performed (money follows cooperation line procedure).

Furthermore, for researchers moving abroad, there are also possibilities to transfer SNF funding to finalise the project. A specific agreement has been signed with Austria and Germany (D-CH-AT cooperation).

As a general rule, nationality is not a criterion for participation in Swiss research programmes. What is generally required instead, is to have a stable long-term

appointment in a Swiss institution (this applies also to professors living in trans-border regions and working in Swiss universities). SNF funding for stays abroad is not restricted to the European Union, hence allows outward mobility to third countries as well. Most funding from SNF and CTI has to be spent in Switzerland (with some exceptions for justified reasons), however.

Cooperation with third countries generally differs little from cooperation with partners from the EU. Hence, the general international orientation of Swiss research and innovation policy applies for third countries as well. Similarly, those programmes that allow foreign institutions to acquire funding, for instance, Sinergia and SCOPES, are open to both Europe and third countries. The Sinergia programme, which is financed by the SNF, offers a platform for inter-, multi- and unidisciplinary projects brought into being through the initiative and collaboration of different research groups. The SCOPES programme (Scientific co-operation between Eastern Europe and Switzerland), which is financed by the SNF and the Swiss Agency for Development and Co-operation promotes scientific co-operation between research groups and institutions in Switzerland and Eastern Europe.

Furthermore, the ERI message defined a number of countries that have priority in respect to developing bilateral research ties. These are China, India, Russia, South Africa, the Ivory Coast, Tanzania, Japan, South Korea, Brazil and Chile.

When looking to the relevance of the ERA for Swiss research policy, one needs to consider that Switzerland is not a member of the EU and thus, unsurprisingly, very few references to ERA policies can be found in Swiss official documents. However, by and large Swiss research policy complies with ERA objectives and, to some extent, already fulfils them better than many EU countries.

This is the case for example for researcher's mobility, where the Swiss researchers market is one of the most open internationally (about half of the PhD students and of the university professors are of foreign nationality). The impact of the EU in this context has to be sought rather in the liberalisation of the labour market and of people mobility in general, against a traditionally restrictive Swiss policy in these domains.

In the domains of research infrastructures and opening of research programmes, Switzerland is following the decentralised and bottom-up approach which broadly characterises its research policy. Thus, participation in European infrastructural initiatives and international programmes, as well as opening of national programmes, is decided case by case when the research community shows an interest for them. This highly effective approach entails however some risks in case the EU launches large-scale joint schemes, where participation has to be decided at the political level (as the non-participation of Switzerland to Joint Technology Initiatives might show).

The bottom-up approach and the focus on funding of basic research coupled with competitive funds for joint public-private research projects has to be judged positively given the Swiss tradition of delegating as much as possible responsibilities to researchers in defining their priorities. However, politics should develop a clear framework of coordination between research and to innovation policy in order to build a bridge between both domains. In the case of Switzerland, formal principles of coordination between SNF and CTI can be easily implemented since both institutions follow the same principles in deciding on funding.

The most important challenge for Swiss research policy is undoubtedly to strengthen its universities and to allow them to position themselves in the European and international context. While this is already the case for some of them – especially for the two Federal Institutes of Technology – cantonal universities need a stronger effort in this direction. At the political level, initiatives have been undertaken to grant universities wider

autonomy and strategic capability but conflicts emerged in this respect between some universities and cantonal authorities. Moreover, today's governance of Swiss higher education is too fragmented between different jurisdictions and regulations are widely different between types of HEI (cantonal universities vs. Federal Institutes of Technology vs. UAS). A new higher education act was adopted by the parliament in September 2011. It will provide a common regulatory framework for the whole system and establish a joint governance body between the Confederation and Cantons.

**Table 3: Assessment of the national policies/measures supporting the strategic ERA objectives (derived from ERA 2020 Vision)**

	ERA dimension	Main challenges at national level	Recent policy changes
1	<b>Labour Market for Researchers</b>	Although labour market is very open, Switzerland is not a EU member and there is serious opposition against the bilateral agreement between EU and CH	Bilateral agreement on free movement between the EU and Switzerland
2	<b>Cross-border cooperation</b>	Bilateral treaties might be excessively costly	Basic research funding treaty between research councils in CH, DE and AT
3	<b>World class research infrastructures</b>	Budgetary constraints, fragmented responsibilities	No policy changes, it is planned to include the SRRI as an official strategy
4	<b>Research institutions</b>	Universities might be improved by increasing autonomy, accountability and budgets; public research institutions other than universities of minor significance	Prioritising of competitive funding schemes in budget developments of federal government
5	<b>Public-private partnerships</b>	CTI has only limited resources and limited working areas	Pilot phase of CTI voucher (CTI covers the costs of a research partner and the implementation partner looking for a research partner and helps to set both the timetable and milestones for the innovation project) Innovation Cheque Reform of the CTI's legal status.
6	<b>Knowledge circulation across Europe</b>	Same as in 2	Basic research funding treaty between research councils in CH, DE and AT
7	<b>International Cooperation</b>	Same as in 2	Networking events with selected countries across the world

## Annex: Alignment of national policies with ERA pillars / objectives

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### *1. Ensure an adequate supply of human resources for research and an open, attractive and competitive single European labour market for male and female researchers*

#### **1.1 Supply of human resources for research**

Switzerland has the highest proportion of human resources in sciences and technology of all employees among all European countries (54.4% in 2009, compared to 40.1% in EU-27). This proportion has increased considerably during the last years. Relative to the size of the population, Switzerland also has the highest number of doctoral students in science and technology. However, in many sectors in the economy, there still has not been enough supply of skilled employees to meet the demand. As a consequence, inward flows of researchers are very important for Switzerland. The Swiss research sector traditionally exhibits a high degree of openness. The share of foreigners in the private research sector amounts to 32% and the corresponding share in universities to 36% (FSO, 2010c). Similarly, 48% of PhD students were of foreign origin in 2008 (FSO, 2010d).

Outward flows are not relevant for Switzerland because of the country's size and the very limited number of domestic researchers. Because the overall situation of the Swiss labour market for researchers is comparatively good concerning the number of positions and the employment situation, emigration of researchers is not a problem (although the transition from one career level to the next in academics could cause problems because the number of positions decreases at higher levels of the career ladder; additionally, academic positions are often temporary). During phases of economic growth, there has been repeatedly a shortage of qualified workers both for public and private positions.

In a positive sense, outward mobility is high as well as signified by a share of more than 20% of undergraduate students having staid abroad in 2008 (FSO, 2010f). There is also a strong tradition of mobility of Swiss PhD students, thanks especially to a specific grant scheme of the SNF for research stays abroad of young researchers.

#### **1.2 Ensure that researchers across the EU benefit from open recruitment, adequate training, attractive career prospects and working conditions and barriers to cross-border mobility are removed**

In the university sector, the career structure has been reorganised in recent years. After the doctorate, the career structure is based on different types of temporary post-doc positions. Permanent researcher positions are very rare. Funding and working conditions for PhD students and other researchers are favourable since salary levels are very attractive compared to the EU-27 (European Commission, 2007). Both seniority and performance are acknowledged in determining salaries.

Of the 20,000 doctoral students enrolled in Swiss universities in 2010, about 50% came from abroad, showing the openness and competitiveness of Swiss universities (FSO, 2010d). Most of the foreign employees at universities (including professors as well as research staff at doctoral or post-doctoral level), namely about 58%, come from surrounding countries, that is Germany, France and Italy. Germans alone account for about 38% of foreign employees in this sector (FSO, 2010e). Rules concerning academic personnel in Swiss universities make little distinction between Swiss and foreign applicants. There are no recruitment procedures that may hinder the openness or discourage participation of non-national applicants. Generally, research vacancies are advertised in English, recruitment processes are rather transparent. The contract situation is the same for both national and non-national researchers. Generally, permanent research positions below the professorial level are rather rare, but it is the same situation for Swiss and non-Swiss researchers. The same applies to personnel to be engaged in SNF funded projects. Barriers to engaging foreign researchers mostly arise from labour market and immigration regulations. De facto, immigration policy in the academic domain has been more liberal than official regulations and since the legal validity of the bilateral agreements with the European Union, researchers from these countries face no disadvantages anymore. Hence, the share of foreign university staff was 27% in 1995, reaching 40% in 2010 (FSO, 2010g).

All universities and most of the other research institutions have signed the Charter for Researchers and the Code on Conduct for the Recruitment of Researchers (on the whole 28 institutions). Within the framework of the Swiss-EU Bilateral Agreement on Free Movement of Persons, Switzerland works closely with the European Union and has adopted the EU's system of mutual recognition of foreign qualifications issued by EU member states. Third-state nationals are also entitled to apply for recognition of their foreign qualifications in Switzerland.

The SNF has made some progress in increasing portability of grants abroad; as a general rule, transferring funds is allowed if a project responsible gets a position abroad for concluding already started projects. Funding of research groups abroad is generally not allowed, though a planned research visit to a foreign institution is considered an asset and is hence often financed. A notable exception is the Sinergia instrument, which allows funding of a single crucial research group from abroad within a consortium of three to six research groups. A specific agreement has been signed with Austria and Germany (D-CH-AT cooperation).

### **1.3 Improve young people's scientific education and increase interest in research careers**

The number of PhD students has been steadily increasing from 3,100 in 2000 to 3,600 in 2010 (FSO, 2010a). The number of permanent research staff has evolved at a much lower rate. PhD education is strongly promoted by the SNF. About 90% of the personnel paid through SNF grants are at the doctoral level. A doctoral dissertation and the training of researchers are considered to be the main outcomes of these projects. Moreover, SNF invests about one fifth of its yearly budget in a whole range of instruments to support PhD students and researchers in the early career stages. These schemes have been progressively extended to cover all stages of scientific careers below the professorial position. In addition, cantonal universities have begun to pay more attention to education at doctoral level and to create structured doctoral programs.

Vocational training has a very strong position in the system of education in Switzerland (two third of all adolescent persons obtain a basic training). With respect to the provision of an appropriate mix of skills, a major problem might be that the number of entries and degrees in social and human sciences is much higher than in natural and technical sciences. In addition, the number of students in social and human sciences is still increasing so that the gap will not be closed in near future. Although a strong vocational training can work against a lack of engineers etc., there is still the problem of providing enough employees with a sound education. In the field of permanent education, Switzerland holds a top rank with respect to the number of participants in qualification trainings (Federal Council, 2007).

Entrepreneurship training is not widely available or included in curricula, but for students (for instance at ETHZ), who are interested, it is possible to take such courses. There is also a recent initiative of the CTI called Venturelab with the aim of improving entrepreneurial education. The same is true for training in communication skills. Although curricula do not explicitly involve creativity or critical thinking, it is clear that students are indirectly trained in these skills during their education given the overall quality of higher education in Switzerland.

### **1.4 Promote equal treatment for women and men in research**

The proportion of female research assistants at Swiss universities is about 41%. There is strong variation depending on the type of university. For example, the technically oriented ETHZ has a proportion of 30% female researchers. Only 17% of the professors are women (FSO, 2010e).

In the strategy plans, it is acknowledged that the SNF should continue efforts to increase the proportion of women in sciences. In addition, the SNF is asked to evaluate and improve equality of women and men in all its promotion measures. However, there are no concrete measures that go beyond statements of intentions. Maternity leaves and salaries during maternity are regulated at decentralised levels rather than on federal level, e.g. in the regulation of the ETH council about human resources. Therefore, although there are rules in almost every institution, it cannot be provided a broad picture. The same is true for childcare.

The relatively high gap of 23% between the average salary of men and women suggests that equal opportunity has not been realised yet, despite both the government and individual universities promoting equal opportunities (for instance, [Marie Heim-Vögtlin Program](#)). The relevance of maternity leave is also reflected in the lower slope coefficient for women measuring the relationship between remuneration and seniority (European Commission, 2007). Therefore, the CTI introduced a measure called Diversity@CTI,

which focuses on improving guidance of female researchers and entrepreneurs, for example by raising the share of female coaches.

## ***2. Facilitate cross-border cooperation, enhance merit-based competition and increase European coordination and integration of research funding<sup>4</sup>***

The SNF facilitates mobility of researchers in a number of ways, in particular by allowing foreign researchers working continuously at Swiss universities to apply for any type of funding. Furthermore, the SNF offers funding instruments for short-term and medium-term stays abroad. The SNF also provides funding for the organisation of international workshops and conferences. Since 2009, the SNF and the German and Austrian funding agencies for basic research acknowledge funding decisions of each other concerning applications with research groups among these countries implying that cross-country applications will only be evaluated by a single agency. The Swiss participation in the ERA-NETs also promotes international research collaboration.

In general, only applicants with an affiliation with a Swiss institution or with a Swiss domicile can apply for funding. However, the National Research Council that reviews applications to SNF can allow for exceptions and grant funding to researchers abroad. Generally, programmes are open to natural and legal persons (including PROs, HEIs and firms). The rationale of this scheme seems to be to first address researchers with an affiliation or domicile in Switzerland, at the same time not to exclude other applications in advance.

## ***3. Develop world-class research infrastructures (including e-infrastructures) and ensure access to them***

The issue of research infrastructures has not been very prominent in the Swiss context until recently. Reasons are the decentralised organisation of research activities with limited steering from the State, the lack of focus on strategic thematic domains and the small size of the country which leads to the delegation of many infrastructure issues to international organisations. Thus, Switzerland is a founding member and full partner of most international research organisations and Swiss researchers are among the most successful users of these facilities. Hence, Switzerland may participate in research infrastructures based on membership in research organisations. Switzerland is also an associated member of the European Strategy Forum on Research Infrastructures (ESFRI).

In line with the revision of the Federal Law on the Promotion of Research and Innovation (FIFG) in November 2011, it is planned to include the so-called Swiss Roadmap for Research Infrastructures (SRRI) as an official strategy. Hence, support of research infrastructures will be an integral part of the 2013-2016 message. The SRRI is a survey which was generated bottom-up including scientific expertise and opinions of the CRUS. It includes 17 research infrastructures that are of a high scientific priority for Switzerland. At national level, large-scale facilities in natural sciences and engineering are the PSI, EAWAG which is a world-leading aquatic research institute, and EMPA which is an interdisciplinary research and services institution for material sciences and technology development. In addition, the WSL is concerned with the use, development and protection of natural and urban spaces. PSI, EAWAG, EMPA and WSL all belong to the ETH domain. To prepare the Swiss research system to the new generation of computing machines, an ambitious action plan is under preparation. It includes a scientific cooperation project between the Swiss National Supercomputer Centre and Swiss universities to develop applications in different domain sciences, the construction of a new building and the purchase of a next generation machine which should be operational around 2012.

In addition, the Swiss Confederation supports several research infrastructures, in particular the Swiss Institute for Bioinformatics (SIB), the Swiss Institute for Art Research and the Swiss Center of Expertise in

<sup>4</sup> Promote more critical mass and more strategic, focussed, efficient and effective European research via improved cooperation and coordination between public research funding authorities across Europe, including joint programming, jointly funded activities and common foresight.

- Ensure the development of research systems and programmes across the Union in a more simple and coherent manner.
- Promote increased European-wide competition and access of cross-border projects to national projects funding

the Social Sciences (FORS). The SIB is an academic, non-profit foundation recognised of public utility and established in 1998. SIB coordinates research and education in bioinformatics throughout Switzerland and provides high quality bioinformatics services to the national and international research community. The Swiss Institute for Art Research is a non-profit competence centre in arts with majors in research, documentation, knowledge transfer and information and focus on Swiss art. FORS is a national centre of expertise in the social sciences. The purpose of FORS is to enhance work in the social sciences by providing data and services to researchers, conducting methodological research, and publishing research findings.

The RIs in the ETH domain are generally accessible to foreigners; especially the PSI has special programs for this issue.

Regarding the actual legal situation, Switzerland is not able to join the European Research Infrastructure Consortium (ERIC), but can set up an ERIC as an associated member of the EU framework programme for research and innovation.

#### ***4. Strengthen research institutions, including notably universities***

The quality of the university system is very high and above the European average. This is also reflected in international rankings. In the bibliometrics-based Leiden Ranking of European universities two of the top-twenty universities are Swiss (ETHZ and ETHL are at the top in Europe). In the Shanghai Ranking and in the Times Higher Education (THE) Ranking ETHZ comes at position 23 and 15, respectively, as the best university in Continental Europe. Furthermore, three Swiss universities are in the top 100 in the Shanghai and THE Ranking (Leiden Ranking, 2011, Shanghai Ranking, THE, 2011).

Each university has an internal quality assurance programme overseen by the SUC. The SUC has also developed a general quality framework to facilitate the Bologna process.

Traditionally, the Swiss university system has been considered as a combination of bureaucratic control from the Cantons concerning general strategy and administration and of large autonomy of the professors concerning research and teaching, as well as in hiring academic personnel. Cantonal competence protected this autonomy by restraining the central State to the issue of common directives. Correspondingly, university central boards and the ability of universities of defining their own strategy were limited by cantonal politics and by the autonomy of the academic base.

Reforms aimed to increase the autonomy of universities and the power of governing board started in the 1980s, under the pressure of restrictions in funding and of the increase in the number of students, but also thanks to the diffusion of new policy models (new public management) both at the cantonal and at the federal level. The direction has been similar in all Cantons, strengthening the role of the rector or the president, broadening the competences of the higher governing board (the university council), shifting from line-item budget to global budget allowing internal redistribution and the creation of reserves and, finally, deregulating contracts and salaries (with the exceptions of professorial levels). Moreover, universities were requested to produce regularly strategic plans, which are consolidated in a national planning by the Conference of Rectors.

However, the impact of these reforms has differed from case to case (Fumasoli, 2007): in some Cantons, universities received more managerial autonomy, but strategic decisions (for example on main research fields) are still firmly in the hands of the cantonal government, while in other cases the university council has become a strategic organ with real power and the rector/president enjoys considerable autonomy. Given their position at arm's length from the Confederation, Federal Institutes of Technology are much more advanced in this process than most cantonal universities.

Swiss universities are increasingly under pressure to define a more focused profile of their activities, as a consequence of stronger selectivity of research funding, of the need of positioning in the European and international university landscape and of the limitations of funding for education. However, situations are very different: the two ETH's are firmly positioned as leading international universities and some large universities like Zurich and Bern can keep their position and a broad profile. On the other hand, medium and small universities need to focus on some strong areas and make difficult strategic choices, such as whether to abandon most of natural sciences (Lausanne) or the cost-intensive but prestigious microtechnics department (Neuchâtel). While federal policy by and large promotes autonomy and competition between universities,



some Cantons try to keep control of their own universities and to follow a more regional logic, leading in some cases to conflicts with university governance bodies.

Despite the good results of decentralised coordination through cooperation projects, there is clearly a need to overcome the current fragmentation of governance and regulatory framework of higher education. At federal level, three separated acts rule the Federal Institutes of Technology (under full federal competence), the support to cantonal universities (with no regulatory competence of the Confederation) and the UAS (with a federal competence to edict general rules). Moreover, there are wide differences in cantonal university laws and funding mechanisms are different according to the type of institution. The only common body in Swiss higher education, the SUC, has no mandatory competences and its intervention is limited by the need to gain the consensus of all Cantons on joint decisions.

A new higher education act, which should provide a common regulatory framework for the whole system and establish a joint governance body between Confederation and Cantons, is currently was adopted in September 2011.

In the area of monitoring, the OAQ prepared guidelines for quality management and monitors the quality of universities. All cantonal universities have installed quality management guidelines.

In the ETH domain, fragmentation is not a problem as all responsibilities are concentrated on federal level. This facilitates evaluation of the whole domain. The ETH domain is evaluated regularly. The ETH board reports primarily to the Confederation, indirectly to the Federal Parliament and, particularly regarding the annual report, to the interested public. For the ETH domain, a central role is played by the ETH Board's three-part reporting system. This comprises the annual report, the interim evaluation in the middle of the usually four-year performance period and the final report at the end of that period. Halfway through the performance period, the ETH Board draws up a self-assessment report which provides an overview of the extent to which the objectives of the performance mandate have been achieved. This report forms the basis for an external peer review, which is commissioned by the Federal Department of Internal Affairs. The self-assessment report, the external peer review and the corresponding statements combined constitute the so-called interim report. The Federal Department of Internal Affairs always submits this to the Federal Parliament together with the application for the next performance period's global budget. At the end of the performance period, the ETH board provides a final report on how the performance mandate was fulfilled during the expired performance period. The final report must be approved by the Federal Parliament. Within the scope of its obligation to report annually to the Confederation, the ETH board illuminates various aspects of the development of the ETH domain. The annual report is a critical self-assessment of the ETH domain conducted by the ETH board, combined with a report on how the annual federal financial contribution is put to use. This report is based on the objectives of the performance mandate and is submitted to the Federal Council. However, it is also directed to the Federal Parliament and the interested public. The ETH domain's consolidated financial statements comprise the balance sheet, the income statement, the investment statement, the cash flow statement and notes. It is submitted to the Federal Parliament as an appendix to the government account. The ETH board also prepares annual technical reports, which it has to submit to the Federal Administration.

## ***5. Facilitate partnerships and productive interactions between research institutions and the private sector***

Promotion of cooperation and technology transfer reflects a central element of the Swiss research and innovation policy. The SNF fosters cooperation among researchers by using it as an evaluation criterion. Furthermore, it provides instruments explicitly requiring cooperation, notably the interdisciplinary instruments NRP and NCCR.

Promotion of cooperative research between higher education institutions and private companies is the main route for direct support from the State to technological innovation, especially in companies without their own research capacity. Most of the budget of the CTI is devoted to these projects. The CTI's measures target essentially SMEs.

Utilisations and patents of inventions made by researchers in the ETH domain are assigned to the ETH if inventions were made within official working time. Otherwise, inventions made in leisure time or under contracts of the inventor with third parties can be assigned to inventors. The FIFG specifies utilisation of

research results in the way that research institutions must take care that their research results are available for public. They also must support analysis and utilisation of research work. There are no limitations with respect to inter-sectoral mobility, i.e. researchers can choose whether they want to change to the private sector. The converse is also true. In fact, the option to continue the career in research labs of private companies is chosen by many researchers who have started their career at university.

The ETHs have Knowledge Transfer Offices. However, this is not true for all universities. As knowledge transfer is a central element in Swiss innovation policy, almost all capacities for innovation support are addressed to this topic. Therefore, knowledge transfer is well developed and funded, especially in institutions such as CTI and SNF.

Cantonal universities have university councils where persons from business sector can become a member, but influence from business sector is not mandatory.

## ***6. Enhance knowledge circulation across Europe and beyond***

Given the size of Switzerland the SNF encourages knowledge circulation through various instruments. Most importantly, the SNF facilitates mobility of researchers in a number of ways, in particular by allowing foreign researchers working continuously at Swiss universities to apply for any type of funding. Furthermore, the SNF offers funding instruments for short-term and medium-term stays abroad.

The SNF also provides funding for the organisation of international workshops and conferences.

Furthermore, since 2009, the SNF and the German (Deutsche Forschungsgemeinschaft, DFG) and Austrian (Österreichischer Wissenschaftsfonds, FWF) funding agencies for basic research acknowledge the funding decisions of partner agencies concerning applications with research groups among these countries, implying that cross-country applications will only be evaluated by a single agency. The promotion of cooperation by the CTI targets Swiss universities but is not restricted to Swiss firms, and thereby fosters cross-border cooperation as well. Finally, the Swiss participation in the ERA-NETs promotes international research collaboration further.

While the SNF supports individual infrastructure projects, this instrument has no explicit international dimension. On the other hand experiments at CERN are promoted explicitly.

## ***7. Strengthen international cooperation in science and technology and the role and attractiveness of European research in the world***

In 2008, the European Commission proposed the [Strategic European Framework for International Science and Technology Cooperation](#) to strengthen science and technology cooperation with non-EU countries.

The strategy identifies general principles which should underpin European cooperation with the rest of the world and proposed specific orientations for action to: 1) strengthen the international dimension of ERA through FPs and to foster strategic cooperation with key third countries through geographic and thematic targeting. 2) improve the framework conditions for international cooperation in S&T and for the promotion of European technologies worldwide.

Cooperation with third countries generally differs little from cooperation with partners from the EU. Hence, the general international orientation of Swiss research and innovation policy applies for third countries as well. Similarly, those programmes that allow foreign institutions to acquire funding, for instance, Sinergia and SCOPES, are open to both Europe and third countries.

Switzerland has a rather good tradition of participating in international programmes at the European level. It participates in the Cooperation in Science and Technology in Europe (COST), where the State Secretariat for Education and Research provides additional funding for research in COST actions with Swiss participation.

Total expenditures amounted to about €5m in 2011 (Federal Council, 2010). It further participates in the European technology initiative EUREKA, where Swiss participations are funded through the CTI.

Switzerland also supports a number of inter-governmental research infrastructures, namely ESA, CERN, ESRF, EMB, ESO, ILL, CIESM and HFSP. Total funding in 2011 amounted to €150m where the bulk is spent for participation in ESA programmes (Federal Council, 2010). Switzerland also participates in the European framework programmes. Swiss researchers were quite successful in acquiring funds from the 6<sup>th</sup> framework programme. Swiss research benefits from about €160m third-party funds per year from the European

framework programmes. Therefore, the net flow of money was positive, for instance, Swiss researchers acquired more money than the government spent (SER, 2010a).

As a general evaluation, Swiss participation in international programmes and opening of national programmes reflects the decentralised nature of Swiss research policy and the lack of planning in respect to research topics. Thus, research funding organisations are generally willing to participate and their funding situation allows finding resources for these activities. The funding situation of Swiss partners in ESF initiatives, COST and Eureka is generally more favourable than in the other European countries.

Switzerland reached an agreement with Germany (DFG) and Austria (FWF) concerning joint financing of bilateral or trilateral projects, where submission and evaluation takes place in one of the three countries, while funding is on national basis (lead agency procedures) or from the country where most of the research is performed (money follows cooperation line procedure).

Furthermore, for researchers moving abroad, there are also possibilities to transfer SNF funding to finalise the project. A specific agreement has been signed with Austria and Germany (D-CH-AT cooperation).

Within the 6<sup>th</sup> framework programme, Switzerland spent about €150m per year (SNF, 2008). It participated in 20 projects in the context of ERA-NETs, increasing to 21 in the 7<sup>th</sup> framework programme. These are located within the following ERA-NETs: ASPERA-2, CHIST-ERA, CONCERT-Japan, CORE Organic II, ECO-INNOVERA, EMIDA, ENR2, ENT II, ERA-ARD II, ERACOBUILD, ERAfrica, EuroNanoMed, ICT-AGRI, iMERA-PLUS, MATERA+, MNT-ERA.NET II, RURAGRI and SmartGrids ERA-NET (SER, 2010b).

In respect to the Swiss participation in initiatives undertaken under Art. 185 of the Lisbon Treaty, Switzerland takes part in AAL reserving €2m per year and in the Eurostars initiative as a part of Eureka (OPET, 2010, 2011).

Switzerland participated in a number of projects of the ESF beside of contributing to the general budget in 2009. However, it only participated in one project besides its general membership contribution in 2010 (SNF, 2010, 2011).

To the contrary, there is no Swiss participation to joint activities in JTI since there is no Swiss funding available. Swiss private companies and research organisations can participate on an individual basis to selected JTIs, but have to bear their own costs.

As a general rule, nationality is not a criterion for participation in Swiss research programmes. What is generally required instead, is to have a stable long-term appointment in a Swiss institution (this applies also to professors living in trans-border regions and working in Swiss universities). Most funding from SNF and CTI has to be spent in Switzerland (with some exceptions for justified reasons). However, SNF funding for stays abroad is not restricted to the European Union, hence allows outward mobility to third countries as well.

However, in recent years, the SNF has opened up somewhat to international collaboration as exemplified by:

- The Sinergia programme, launched in 2008, supports cooperation networks of 3-4 research teams in basic research. The programme is open to the participation of a partner abroad (including SNF funding), if its competences are critical for the success of the project.
- The cooperation programmes with Eastern European Countries (SCOPES) and with developing countries allow funding research and capacity building in these countries directly. Concerning SNF grant schemes a distinction has to be made between early and later career stage schemes. Early stage career grants for a research stay abroad are reserved to PhD students of Swiss universities. The Ambizione programme for post-docs is open to applicants from abroad, while the SNF assistant professor programme requires a Swiss university diploma or at least two years of activity in a Swiss university (but a stay abroad is a mandatory requirement).

Furthermore, the ERI message defined a number of countries that have priority in respect to developing research ties. These are China, India, Russia, South Africa, the Ivory Coast, Tanzania, Japan, South Korea, Brazil and Chile. Hence, the ERI message

<http://cordis.europa.eu/erawatch/index.cfm?fuseaction=policy.document&UUID=9F47E380-B654-2A0A-A392016D980F7AD0&hwd=> 2012 earmarks €9m for networking events and joint research projects.

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## List of Abbreviations

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BERD	Business Expenditures for Research and Development
CERN	European Organisation for Nuclear Research
COST	European Cooperation in Science and Technology
CRUS	Conference of Rectors of Swiss Universities
CSCS	Swiss National Supercomputing Centre
CTI	Innovation Promotion Agency
DFG	Deutsche Forschungsgemeinschaft
EAWAG	Swiss Federal Institute of Aquatic Science and Technology
EMPA	Swiss Federal Laboratories for Materials Science
EPFL	Federal Institute of Technology Lausanne
ERA	European Research Area
ERA-NET	European Research Area Network
ERI	Education, Research and Innovation
ERIC	European Research Infrastructure Consortium
ERP Fund	European Recovery Programme Fund
ESA	European Space Agency
ESF	European Science Foundation
ESFRI	European Strategy Forum on Research Infrastructures
ESRF	European Synchrotron Radiation Facility
ETH	Federal Institute of Technology
ETHZ	Federal Institute of Technology Zurich
EU	European Union
EU-27	European Union including 27 Member States
FDI	Foreign Direct Investments
FIFG	Federal Law on the Promotion of Research and Innovation
FP	European Framework Programme for Research and Technology Development
FORS	Swiss Center of Expertise in the Social Sciences
FP	Framework Programme
FP7	7th Framework Programme
FSO	Federal Statistical Office
FWF	Fonds zur Förderung der wissenschaftlichen Forschung
GBAORD	Government Budget Appropriations or Outlays on R&D
GDP	Gross Domestic Product
GERD	Gross Domestic Expenditure on R&D
GOVERD	Government Intramural Expenditure on R&D
GUF	General University Funds
HEI	Higher education institutions
HERD	Higher Education Expenditure on R&D
HES	Higher education sector
IP	Intellectual Property
JTI	Joint Technology Initiatives
NCCR	National Centre of Competence in Research
NRP	National Research Programme

RDI	Research, development and Innovation
OAQ	Swiss Centre of Accreditation and Quality Assurance in Higher Education
OECD	Organisation for Economic Co-operation and Development
OPET	Federal Office for Professional Education and Technology
PRO	Public Research Organisations
PSI	Paul Scherrer Institute
R&D	Research and development
RDI	Research Development and Innovation
RI	Research Infrastructures
RTDI	Research Technological Development and Innovation
S&T	Science and technology
SER	State Secretariat for Education and Research
SF	Structural Funds
SIB	Swiss Institute for Bioinformatics
SME	Small and Medium Sized Enterprise
SNF	Swiss National Science Foundation
SRRI	Swiss Roadmap for Research Infrastructures
SSTC	Swiss Science and Technology Council
SUC	Swiss University Conference
THE	Times Higher Education
UAS	University of Applied Sciences
VC	Venture Capital
WSL	Swiss Federal Institute for Forest, Snow and Landscape Research

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#### Abstract

The main objective of the ERAWATCH Annual Country Reports is to characterise and assess the performance of national research systems and related policies in a structured manner that is comparable across countries. EW Country Reports 2011 identify the structural challenges faced by national innovation systems. They further analyse and assess the ability of the policy mix in place to consistently and efficiently tackle these challenges. The annex of the reports gives an overview of the latest national policy efforts towards the enhancement of European Research Area and further assess their efficiency to achieve the targets.

These reports were originally produced in November - December 2011, focusing on policy developments over the previous twelve months. The reports were produced by the ERAWATCH Network under contract to JRC-IPTS. The analytical framework and the structure of the reports have been developed by the Institute for Prospective Technological Studies of the Joint Research Centre (JRC-IPTS) and Directorate General for Research and Innovation with contributions from ERAWATCH Network Asbl.



As the Commission's in-house science service, the Joint Research Centre's mission is to provide EU policies with independent, evidence-based scientific and technical support throughout the whole policy cycle.

Working in close cooperation with policy Directorates-General, the JRC addresses key societal challenges while stimulating innovation through developing new standards, methods and tools, and sharing and transferring its know-how to the Member States and international community.

Key policy areas include: environment and climate change; energy and transport; agriculture and food security; health and consumer protection; information society and digital agenda; safety and security including nuclear; all supported through a cross-cutting and multi-disciplinary approach.



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