Effects of Swiss participation in EU Research Framework Programmes

Interim report, 2009

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List of abbreviations

CORDIS	Community Research and Development Information Service (http://cordis.europa.eu/home_en.html)
COST	European Cooperation in the fields of Scientific and Technical research
CTI	Innovation Promotion Agency
EPFL	Federal Institute of Technology, Lausanne
ERA	European Research Area
ERC	European Research Council
ETHZ	Federal Institute of Technology, Zurich
EUREKA	Pan-European network for market-oriented, industrial R&D
FIT	Federal Institute of Technology
FP	Framework Programme of the European Community for research, technological development and demonstration activities
JRC	Joint Research Centre of the European Commission
JTI	Joint Technology Initiative
OECD	Organisation for Economic Co-operation and Development
SER	State Secretariat for Education and Research
SME	Small to medium-sized entreprise
SNSF	Swiss National Science Foundation
UAS	University of Applied Sciences
UNIBAS	University of Basel
UNIBE	University of Bern
UNIGE	University of Geneva
UNIL	University of Lausanne
UZH	University of Zurich

Key points

- EU Framework Programmes (FPs) are the main funding schemes for research in the European Union. Swiss researchers have been able to participate in FPs since 1987. Since 2004, Switzerland has had "associated country" status, which allows Swiss researchers to participate fully in FPs, on an equal footing with their European counterparts.
- At the request of the Swiss Parliament, a system of indicators has been established to assess the cost-effectiveness and concrete positive effects of Switzerland's participation in FPs.
- In this interim report, the indicators adopted are presented, together with the data and results available to date. The first complete set of data will be available in 2012 (in time to prepare for Switzerland's participation in the successor to FP7), and data will be gathered every three years.

Results

- On average, Swiss research received around CHF 200 m per year in European subsidies under FP6 (2003–2006), a sum which should increase under FP7 (2007–2013) as a result of the larger budget.
- Since Switzerland became an associated country, the financial return for FPs in Switzerland has been positive. Given the excellent success rate for Swiss research proposals submitted to FP7, the financial return is likely to be further increased.
- The specific features of FPs make them highly complementary to other research funding instruments available in Switzerland (SNSF, CTI, COST, EUREKA) – especially the emphasis placed on collaborative international research.
- Each Swiss participation in a European project generates around two jobs, although in most cases these are of limited duration. Other jobs are created indirectly, via the projects' contribution to the establishment of companies. Economic effects are also expected to arise from applications for patents (or other types of intellectual property) filed at the end of certain projects.
- Research partnerships and the mobility of researchers within European projects help to enhance the coordination and integration of European research.
- The collaborative international approach is essential for numerous cutting-edge research fields. In particular, integration into international research networks provides access to specialist expertise abroad and a better knowledge of the competitive environment. The analysis of collaborative links within European projects shows that Switzerland is highly integrated into the network of large Western European countries, and at the same time open-minded in selecting the national origin of its partners.
- Collaborations between public and private sector research are likewise promoted. More than half of all participations lead to new commercial partnerships.
- FPs finance between 1% and 10% of research at Swiss higher education institutions. They have become a significant source of third-party funding and a strategic element in the promotion of research in the higher education sector.
- Certain companies finance up to 40% of their R&D activities with the aid of FPs, which also offer them integration into networks, improving their knowledge of the competitive environment, and provide them with access to expertise across Europe.
- The associated country status accorded to Switzerland following the implementation of the bilateral agreement on research not only entitles the country's researchers to participate in all FP activities, but also allows Switzerland to be represented on several groups and committees established by European institutions in the research sphere. Switzerland can thus play an active role in the creation of a true European Research Area. ■

Summary

EU Framework Programmes (FPs) are the main funding schemes for research in the European Union. Swiss researchers have been able to participate in FPs since 1987. Since 2004, Switzerland has had "associated country" status, which allows Swiss researchers to participate fully in FPs, on an equal footing with their European counterparts. In making available the funds required for Switzerland's participation in the 7th Research Framework Programme (FP7, 2007–2013), the Swiss Parliament also called for "a controlling system [incorporating] the indicators that are needed to assess the cost-effectiveness and concrete positive effects of Switzerland's participation in the various programmes and projects." In this first interim report, all the indicators adopted for this system are presented, together with an analysis of the data already available. Given the inevitable constraints associated with a selection of indicators, this account of the effects of FPs is necessarily partial, despite the careful efforts made to cover all aspects.

The data published in this report is to be supplemented by additional data, thanks to a survey of Swiss participants in European research projects. This survey is to be carried out every three years. The next report, scheduled for 2012 – in time for the preparation of the Dispatch on Switzerland's participation in the successor to FP7 – will be the first based on the complete set of indicators. Besides the intrinsic interest of the results presented here, perhaps greater interest attaches to the establishment of a set of indicators and a procedure for systematic and – in some respects – longitudinal collection of data on Switzerland's participation in FPs. The value of this controlling system is not yet fully apparent, but it will be revealed in due course, as data is accumulated, permitting the more refined analysis requested by Parliament.

FPs and Swiss research

FPs provide around CHF 200 m in funding for Swiss research each year (average for FP6, 2003–2006). They are thus a significant source of third-party funding for Swiss research. This represents approximately half of the amount invested annually by the Swiss National Science Foundation (SNSF) in scientific research, but only some 1.5% of total R&D expenditures in Switzerland (the vast majority being financed by companies).

As the FP7 budget is rising sharply from one year to the next (it was around EUR 5 bn for 2007 and will be almost EUR 10 bn in 2013), the significance of FPs for Swiss research is set to increase as a result. The above-average success rate for Swiss research proposals entails a positive financial return for Switzerland.

The specific features of FPs (collaborative, pre-competitive and largely targeted research, European dimension, funding of private-sector research) make them highly complementary to other instruments available in Switzerland (SNSF, CTI, COST, EUREKA). Some participants even see an explicit link between the COST programme and FPs, with the former making it possible to create a network to support the establishment of a consortium for the submission of a European project. FPs are by far the largest source of public funding for private-sector R&D in Switzerland: almost CHF 50 m was allocated to companies each year under FP6, with more than half (55%) going to SMEs.

Effects on the economy

Each Swiss participation in a European project directly creates about two jobs. The number of people employed in Switzerland as a result of FPs can thus be estimated at 3000 for FP5, and 4000 for FP6 (these are not necessarily full-time positions, and the great majority are fixed-term contracts). More than one in five participations contribute to the establishment of a start-up or spin-off, generating jobs in the longer term. The companies created in this way will be recorded and monitored over the long term as part of the controlling system. FPs contribute significantly to the acquisition of patents (29% of Swiss participants report that they have received or expect to receive a patent within three years after the end of a project). Other types of intellectual property (copyright, trademarks, industrial secrecy, etc.) are three to four times more common than patent applications for the results of European projects – an indication of future economic benefits.

European integration, international and intersectoral collaboration

FPs represent a means of overcoming the fragmentation of the European research system, not only through the mobility of researchers which they facilitate, but also thanks to the collaborative nature of the research projects which they promote. The vast majority of European projects are based on a research consortium, comprising several teams from different member or associated countries. The analysis of collaborations involving Swiss researchers shows that Switzerland is highly integrated into the network of large Western European countries, and at the same time open-minded in selecting the national origin of its partners. In 84% of cases, participation in a European project reinforces existing research collaborations, and in almost 90% of cases it permits the development of new research collaborations. The integration of Swiss researchers within the European landscape is demonstrated by the fact that several hundred have served as project evaluators for FP6, and Switzerland is currently represented on more than a third of the groups responsible for advising the European Commission on work programmes, strategy, goals and priorities for FP7. In addition to international collaboration, European projects also in most cases promote the presence of both public research bodies and private companies in consortiums. A third of the research collaborations involving Swiss participants in European projects are between a higher education institution and a company. These provide opportunities for the two sectors to align their research agendas and to share knowledge and experience. With this crucible of innovation, more than half of all participations lead to the development of new commercial partnerships. In 92% of cases, cooperations established with the main partner in a European project are continued after the end of the project. FPs thus have lasting structural effects.

Long-term impacts of FPs

FPs are designed around political objectives, which means that the expected impacts of these programmes can be outlined in advance. European research is designed to lay the foundations for an innovative European economy and to provide direct benefits for society. Apart from the themes directly associated with technological innovation (e.g. information and communication technology, nanotechnology, biotechnology, space), the major concerns of health, the environment, social welfare and security are also among the priorities of FPs.

Institutional impact of FPs

FPs finance between 1% and 10% of research at Swiss higher education institutions. This – growing – proportion, together with the visibility and prestige which FPs can provide, makes them a significant source of third-party funding and a strategic element at higher education institutions. As a result, most of these institutions have developed structures designed to facilitate and promote participation in European projects. It is estimated that around 200 degrees per year (notably Master's and doctorates) are obtained in Switzerland thanks to support from FPs. The next generation of scientists is also explicitly supported under FP7 by exchange grants for young researchers, with about a third of the recipients being women.

FPs are also important strategic elements for the companies contacted in connection with this study. As well as providing up to 40% of the funding for R&D activities for certain SMEs, they play a role in knowledge transfer, creating or maintaining networks, or increasing participants' knowledge of the competitive environment. For certain large enterprises, the possibility of participating, as a Swiss company, on an equal footing with their European counterparts in all the initiatives arising from FPs is described as crucial for certain fields of research – such is the importance of the international arena.

Success Stories

An analysis of six projects with Swiss participation illustrates the diversity of the concrete effects of European research. Several technology-focused start-ups have taken advantage of FPs to develop a marketable product. The network established for the project allowed them to gain access to the necessary expertise, to become familiar with the competitive environment, and to make sure that the technologies developed were indeed at the cutting edge. The companies are thus contributing to the creation of a totally new market, in which they are positioned as global leaders. Secondly, FPs are more competitive than national programmes. Accordingly, participation in a European project is associated with a certain prestige. This provides the participants with a degree of international visibility and career prospects. Thirdly, the bringing together of researchers with different backgrounds (type of host institution, country, age) in projects that are frequently interdisciplinary is regarded both as a unique opportunity and as a key factor in the success of such projects. The collaborative and international dimension of European projects cannot be regarded simply as an advantage, but must in most cases be considered a necessity. Finally, while FPs are often believed merely to provide support for technological development, several examples demonstrate that they contribute decisively to the development of European policies and standards in a wide variety of areas.

Political benefits of involvement in FPs

The associated country status accorded to Switzerland following the implementation of the bilateral agreement on research not only entitles the country's researchers to participate in all FP activities, but also allows Switzerland to be represented on FP management bodies, on the consultative committees of the European Commission and Council, and on the Board of Governors of the Joint Research Centre of the European Commission. It can thus participate actively in implementing the current FP and in developing future generations of programmes. Therefore, while Switzerland's involvement is clearly advantageous at the national level, it also allows the country to contribute to the creation of a true European Research Area, which is beneficial for Europe as a whole. ■

Introduction

Note

In the interests of readability, the term "Swiss researchers" is used throughout to refer to all researchers whose host institution is based in Switzerland.

European Framework Programmes

At the Lisbon summit in March 2000, the political leaders of the European Union set themselves the goal of, by 2010, making the EU "the most competitive and dynamic knowledge-based economy in the world, capable of sustainable economic growth with more and better jobs and greater social cohesion." In particular, this goal was to be achieved by creating a true European Research Area (ERA), specifically designed to promote careers in research, to encourage industry to invest more in research, and to make a significant contribution to generating growth and sustainable employment.

"Framework Programmes for research, technological development and demonstration activities" (FPs) are the main funding schemes for research in the EU and, as such, form the backbone of the ERA. FPs have two main strategic objectives, namely:

- to strengthen the scientific and technological base of European industry;
- to encourage its international competitiveness, while promoting research that supports EU policies.

They are also designed to promote health, quality of life and environmental protection in Europe. Since 1984, there has been a series of seven FPs, most of which have run for a period of four years. FP7, launched on 1 January 2007, is to run for seven years. The focus of the first FPs was on nuclear energy, but information technology has been an important element since FP2, at the end of the 1980s. The thematic scope of the FPs tended to become broader, and they came to include social and economic objectives. Until FP4, the added value attributed to networks, cohesion and economies of scale[1] was sufficient to justify the existence of the FPs. FP5 was oriented towards socioeconomic benefits, while FP6 was conceived when the Commission launched its ERA initiative. This lent special importance to the FPs, which had become tools of a more ambitious policy. Thus, new instruments were created, permitting research projects on a larger scale , but also promoting transnational cooperation among actors in a given sector[2]. Integration has been pursued even further in FP7, through the promotion of direct pooling of resources by member states and associated countries[3] or industrial actors[4], and the creation of a funding body for basic research (European Research Council), which competes directly with national agencies.

Participation in research projects under FPs is open to researchers in EU member states and in so called associated countries, which have a bilateral cooperation agreement with the EU. Switzerland concluded an agreement of this kind with the EU which came into effect on 1 January 2004, during FP6, and which has been renewed for the duration of FP7. This agreement allows Swiss researchers not only to participate in, but also to propose and coordinate European research projects.

[1] Integrated projects (IP), networks of excellence (NoE)
[2] European Technology Platforms (ETP), ERA-NET
[3] ERA-NET Plus, initiatives under Art. 169 of the EC Treaty
[4] Joint Technology Initiatives (JTI)

Parliamentary mandate for evaluation of the effects of FPs

In approving the financing of Switzerland's participation in FP7, Parliament charged the SER with the following task[5]:
"When the first funds are released under the framework credit, a controlling system is to be established, incorporating the indicators that are needed to assess the cost-effectiveness and concrete positive effects of Switzerland's participation in the various programmes and projects."
The reference in this mandate to "various programmes and projects" implies firstly that the scope of the study is not restricted to a particular FP, and secondly that two levels of analysis (programmes as a whole and individual projects) are relevant.

Procedure for data collection and schedule for reporting

In establishing the system of indicators, a number of constraints have had to be taken into account, based on the nature and availability of the data required, as well as the political framework for this study. Firstly, given the current state of national/European databases on European projects, it is necessary for data to be collected ad hoc directly from participants, via a questionnaire or interviews. Secondly, a period of at least 3 years is required between the end of a project and the collection of data, so that the relevant effects can be manifested. Thirdly, a high rate of responses to questionnaires needs to be ensured, as well as the quality of responses. This means that the number of surveys of researchers – who are already in demand for other studies – should be limited as far as possible. Finally, recent, good-quality data will be required for the preparation of the Dispatch on Switzerland's participation in the successor to FP7, on which Parliament will have to vote in 2013.

For all these reasons, the SER has decided, in this interim study for 2009, to establish the system of indicators and to make use of data that is currently available, or available from a limited number of actors (cf. Chapter 5). Collection of data from Swiss researchers in accordance with this system of indicators will begin in 2011 and will be carried out every three years. The first definitive report containing all the relevant data will be published in 2012, providing a basis for the preparation of the Dispatch on Switzerland's participation in the successor to FP7.

This approach was presented on the one hand to a number of federal bodies (Swiss Federal Statistical Office, Federal Office for Professional Education and Technology) and to the Swiss National Science Foundation, and on the other hand to officials responsible for evaluation of research programmes from most European countries, at a workshop co-hosted by SwissCore[6]. The criteria for the selection of indicators, as well as the list of indicators itself, were reworked in the light of the feedback obtained. Finally, a preliminary version of the system of indicators was discussed with National Councillor Martine Brunschwig Graf, the originator of the controlling system, whom we wish to thank in particular for her contribution to the definitive form and content of the project.

Content and structure of the study

Evaluation of the impacts of a scientific research programme involves a number of methodological difficulties (cf. Annex B). Briefly, these are due to the impossibility of ascribing a particular phenomenon of interest to a single identifiable cause – such as the funding of a research programme – within a system as complex as that of our society, and several years (or even decades) after the initial financing. Certain long-term impacts may be perceived in qualitative terms among the institutions or people participating, as is the case for the influence of FPs on the research policies of higher education institutions and companies, or the expected impact of individual research projects (cf. Chapter 5). However, only shorter-term results are amenable to measurement by indicators. It is also relevant to know these results, which provide an insight into the effects of a programme just a few years after its completion, as opposed to at least ten years in the case of longer-term impacts.
Consequently, this report is structured along these two main lines. Chapters 1–4 analyse the indicators selected, focusing on medium-term effects. Chapter 5 considers the longer-term im-

[5] Federal Decree of 14 December 2006 on the financing of Switzerland's participation in the EU programmes for research, technological development and demonstration activities during the period 2007 to 2013 (Art. 1, Para. 5).
[6] Swiss contact office for Eurpean Research, Innovation and Education, in Brussels

pacts (demonstrated or expected) of FPs. The list of indicators and measurements is given in Annex A.

The indicators have been classified under four headings: effects on support for research, effects on the economy and employment, effects on scientific collaboration networks, and effects on the generation of knowledge and skills. Each indicator is associated with a particular *level* (input, output, result, impact), depending on when the effect in question occurs and how far it extends – from the individual researcher to society as a whole. Each indicator is also associated with one or more *impacts*, to which the effect in question should contribute. These expected impacts are the political objectives of FPs, namely (1) growth, competitiveness and employment, (2) sustainable development, (3) social welfare and (4) development of knowledge and communication. The final choice of indicators sought to achieve a balanced coverage of categories, levels and impacts. Wherever possible, the indicators are placed in context (comparison with other national or international measurements, data relating to other research programmes, for example). For the reasons mentioned in the previous paragraph, the data required is not yet available for all the indicators. The indicators as yet unavailable, as well as partial or provisional data, are greyed out in Annex A.

Apart from the information revealed by the indicators, what is perhaps even more interesting about this report is the establishment of the system of indicators and the initiation of a systematic and – in some respects – longitudinal process of data collection within this framework. The added value of a system of this kind will become apparent over the long term. ■

1 Effects on support for research

One obvious first effect of participation in FPs is the existence of an additional source of funding for Swiss research. The indicators discussed in this chapter show how this source of funding fits into the current research funding landscape in Switzerland and what purely financial benefits derive from participation in FPs.

1.1 Financial return (indicator 1.1)

In total, Swiss research has received more than CHF 2.1 bn in subsidies from FPs since the beginning of FP3 (1991). Until the bilateral agreement on research – granting Switzerland the status of an associated country – came into effect on 1 January 2004, Swiss participation in European projects was directly funded by the Confederation. This explains why the financial return for FP3, FP4 and FP5 is precisely equal to Switzerland's financial contribution to these FPs. The total Swiss contribution to FP6 (2003–2006) amounts to CHF 775.3 m, disbursed either in the form of subsidies to research projects (project-by-project participation, before 2004) or in the form of contributions to the EU (participation as an associated country, from 2004). The total amount of subsidies committed for Swiss participations under FP6 is CHF 794.5 m. The resultant surplus for FP6 is thus CHF 19.2 m. It is still too early to assess the financial outcome of participation in FP7.

It should be borne in mind that part of the FP budget is devoted, in particular, to financing the Joint Research Centre (JRC), evaluation of project submissions, and administration and management of research projects and FPs in general. The fact that the entire Swiss contribution is returned in the form of subsidies is a major advantage for Switzerland, given that it also benefits from the services of the JRC, and from a research funding agency providing project evaluation and administration "free of charge".

1.2 Coefficient of financial return (indicator 1.2)

Research subsidies are granted on a competitive basis (only the projects judged to be the best of all those submitted obtain funding). The proportion of subsidies awarded to Swiss researchers (3.06% for FP6), as compared with Switzerland's relative contribution to the FP budget (2.68% for FP6), is thus a measure of the competitiveness of its researchers in securing European funds. This value, known as the coefficient of financial return, is 114% for Swiss participants in FP6 as a whole. A value greater than 100%, as is the case for Switzerland, indicates above-average competitiveness.

The coefficient of financial return for FP7 can only be estimated at this point. As a certain period of time elapses between the beginning of an FP and the signing of the first contracts, there is also a certain time lag between Switzerland's first payments and the first returns in the form of subsidies. In 2007, Switzerland contributed 2.64% of the FP7 budget. Very few projects were funded that year, but it is possible to estimate the proportion of subsidies awarded to Swiss researchers on the basis of the results for 2007 and 2008 (as of 8 October 2008). During those two years, Swiss researchers obtained 3.82% of all subsidies. Here again, the coefficient of financial return – 145% – indicates a degree of competitiveness considerably above the average.

1.3 Leverage (indicator 1.3)

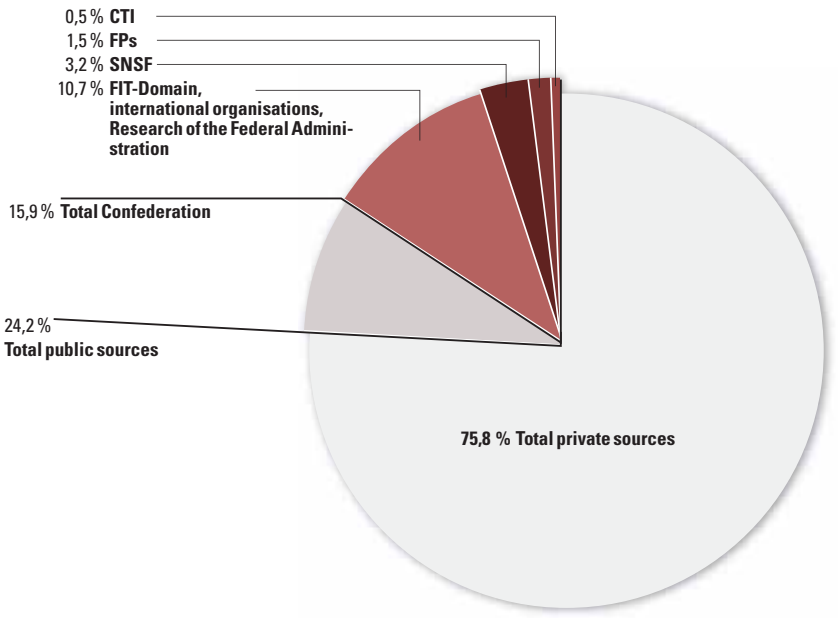
As the costs of research projects are not always completely covered by FPs, participants have to rely on self-financing or third-party funding to carry out their projects. This means that FPs stimulate the investment of additional funds in research. To date, for FP4 to FP7, participating institutions have contributed themselves or secured a total of more than CHF 495.4 m, in addition to the CHF 1861.9 m received in the form of EU or federal subsidies

for their research. On average, the financing of a research project thus stimulates additional investments of more than 25% in the form of self-financing or third-party funding. However, these are not necessarily funds that would not have been allocated to research activities in the absence of the European projects.

Self-financing is particularly substantial in the case of companies, which, for example, contributed an additional CHF 200.6 m, supplementing the subsidies received under FP6 (CHF 202.7 m), so as to complete the research projects in which they were involved. By comparison, the projects funded by the CTI in 2007 (CHF 89.3 m) required the commitment of CHF 127.9 m by private partners (who do not receive CTI funding)[7]. In general, it is estimated for Europe[8] that each EUR 1 increase in public R&D investment produces an additional EUR 0.93 private-sector investment in domestic R&D.

Added to these financial contributions is the work involved in the preparation of European projects, which is not covered by FPs, but which in itself generates results in terms of the networks established in the course of seeking partners, formulating research agendas or structuring projects.

Figure 1
Funding of R&D conducted in Switzerland in 2004
(FPs: average for 2003–2006)



Sources: SFSO (R&D statistics), SNSF, CTI, SER, European Commission

1.4 Additionality (indicator 1.4)

The term "additionality" refers to everything that happens in addition to what would have happened in the absence of an intervention. In this study, we measure the number of research projects which could not have been carried out if European funding had not been granted. This indicator will only be available after participants have been surveyed, in the final study. However, other sources make it possible to put forward certain conclusions. According to a literature review conducted by the European Commission, in 58% to 95% of cases (depending on the study), FPs allow research projects to be carried out which could not have taken place without this support. In the survey commissioned in 2005 by the SER[9], involving only Swiss participants in European projects, 71% of respondents stated that their project could not have taken place without European subsidies. The additionality of FPs is therefore certainly applicable in Switzerland. As well as merely enabling the existence of additional research projects, FPs offer funding options with the benefits of participation outweighing the costs for a majority of Swiss participants (57%)[10].

1.5 Complementarity of R&D funding sources in Switzerland

The five main funding sources for research directly supported by the Confederation are listed in Table 1 below. These funding programmes represent a large proportion of the options offered by the national public agencies, but account for only a small fraction of the total volume of research carried out in Switzerland (CHF 13.1 bn for 2004[11]). Figure 1 shows the relative importance, from a financial viewpoint, of these programmes in the funding of R&D in Switzerland. Figure 2, on p. 20, provides an overview of the various R&D stages covered.

As well as FPs, other European R&D initiatives, associated with FPs in terms of funding but formally distinct, are open to Swiss researchers wishing to participate. For example, these may be initiatives under Art. 169 or Art. 171[12] of the EC Treaty, or certain ERA-NET projects. The funding of Swiss participation in these initiatives, as for EUREKA projects, sometimes involves existing national instruments (e.g. CTI, Federal Office for Agriculture, Federal Roads Office). EU research funding instruments are tending to proliferate, and as a result it is becoming more complex for Switzerland to contribute. This explains why the picture provided by Table 1 is non-exhaustive, and why it will become increasingly difficult to provide such an account in the future.

7 OPET, 2007, Innovation Promotion Agency CTI Annual Report
8 European Commission, 2005, Impact Assessment and Ex Ante Evaluation. Annex to the Proposal for the Council and European Parliament decisions on the 7th Framework Programme (EC and Euratom), COM(2005) 119 final
9 SER, 2005, Evaluation der schweizerischen Beteiligung am 5. und 6. Forschungsrahmenprogramm der Europäischen Union sowie des Informationsnetzwerkes Euresearch
10 *ibid.*
11 SFSO, 2004, R&D statistics
12 In particular, Joint Technology Initiatives (JTI)

Table 1
Characteristics of the five main sources of direct public funding of research in Switzerland

	FPs (average 2003–2006)	SNSF (2007)	CTI (2007)	COST	EUREKA
	European Research Framework Programmes	Swiss National Science Foundation	Innovation Promotion Agency	European Cooperation in the fields of Scientific and Technical research	Pan-European network for market-oriented industrial R&D
Funding	EU + associated and third countries	CH	CH	Intergovernmental (coordination) + CH (research)	Intergovernmental (coordination) + CH (research)
Annual budget available to researchers	Approx. CHF 200 m [a]	CHF 531,3 m	CHF 89,3 m	CHF 7,0 m [f]	Funding provided privately or through existing national schemes
Activities funded	Research ✓ Publications ✓ Networks ✓	Research ✓ Publications ✓ Networks ✓	Research ✓ Publications Networks	Research ✓ Publications ✓ Networks ✓	Research ✓ Publications Networks ✓
Proportion of targeted research	82 % [b]	16 %	0 %	0 %	0 %
Objectives	· To strengthen the scientific and technological base of European industry · To encourage its international competitiveness, while promoting research that supports EU policies · To promote health, quality of life and environmental protection in Europe	· To promote basic research in Switzerland in all scientific disciplines · To promote its competitiveness and integration into international networks, as well as its problem-solving capacity · To support young scientists	· To support projects of considerable importance for the competitiveness of the Swiss economy · To promote cooperation between academia and business	· To strengthen scientific and technical research in Europe by promoting cooperation and interaction among European researchers · To maximise European synergy and added value in non competitive and pre normative research	· To promote European competitiveness · To support SME research
Collaboration required	International [c] ✓ Public-private [c] ✓	International [d] Public-private [d]	International Public-private [e] ✓	International ✓ Public-private	International [g] ✓ Public-private
Criteria for funding	· Adequate fit with research programme · Scientific excellence	· Scientific excellence	· Degree of innovation · Economic potential · Half the project costs covered by private partners	· Scientific excellence	· Degree of innovation · Economic potential · Benefits of European collaboration

Notes to Table 1

[a] Subsidies are allocated on a competitive basis; therefore, this total depends directly on the number and quality of project proposals submitted by researchers based in Switzerland.

[b] Marie Curie actions (mobility of researchers) are considered to be non-targeted. FP7 additionally includes a basic, non-targeted research programme ("Ideas" programme, 15% of total budget).

[c] The size of consortiums varies widely, depending on the instruments and FPs. Marie Curie actions (mobility of researchers) and the "Ideas" programme (FP7) finance individual grants.

[d] However, the Sinergia scheme supports collaborative projects in independent research, and each National Centre of Competence in Research (NCCR) consists of a "leading house" and a network of partners from academic and non-academic institutions.

[e] At least one non-profit institution and one company.

[f] Average for 2008–2011, relating only to research funds allocated by Switzerland. Coordination activities are financed directly by the COST programme.

[g] At least two partners from two different member countries.

FPs are highly complementary to other research programmes from the point of view of the direction of research. In fact, 82% of European subsidies are allocated in conformity with a work programme pre-established by the European Commission and member states and associated countries. By comparison, only 16% of SNSF subsidies are distributed within the framework of research programmes, while the theme of the other projects is freely chosen by researchers themselves. The CTI, COST and EUREKA do not define any particular direction for the research which they fund (although research is required to meet the criteria for funding, as specified in Table 1).

In terms of objectives, the picture is different. FPs, the CTI and EUREKA focus explicitly on improving economic competitiveness, whereas the SNSF and COST fund research from a broader perspective. This difference is also reflected by the fact that collaboration between academic and private institutions is required for most European projects and for those funded by the CTI.
FPs, lastly, are among those international initiatives, along with COST and EUREKA, which require partnerships with foreign institutions to release funding, unlike national instruments. This integration into international networks is essential for Swiss research (cf. Chapter 3, p. 21). The advantages of the collaborative aspect of research projects are amply illustrated in the success stories presented below (Section 5.4, p. 32).

Point of view of Swiss actors

These sources of research funding were perceived as complementary by the higher education institutions contacted for this evaluation (cf. Section 5.3.1, p. 29). Basic research appeared in the FPs with the implementation of the FP7 "Ideas" programme by the European Research Council (ERC). According to the higher education institutions, ERC projects are distinguished from SNSF projects particularly by their more international profile, their orientation towards higher research volumes and a less good administrative fit with Swiss higher education institutions. As this programme is highly competitive, young researchers, especially, who receive support are bound to earn recognition. In addition, COST is cited as an instrument facilitating the establishment of a network on the basis of which a consortium can be assembled for the submission of a European project. To this extent, COST may be regarded as a success factor for Swiss participation in FPs.

According to the companies that contributed to this study (cf. Annex B, p. 59), the various programmes are also perceived as highly complementary, together covering different stages of development. Compared with the other programmes mentioned, FPs are perceived as being oriented towards longer-term, more exploratory research, in partnership with institutions from other countries and other stages in the development process. For SMEs in particular, FPs offer the benefit of an increased awareness of the international competitive environment in a given cutting-edge sector, with a slight individual competitive advantage also being gained, since the results of projects are generally made available to all project partners. Participation in initiatives (co-)funded by FPs, especially Joint Technology Initiatives (JTI), is described as crucial for the development of certain companies or for their long-term success[13].

The general view is that the main disadvantage of European projects is the substantial administrative burden, inappropriate for research. Another point sometimes mentioned is the difficulty – inherent in the international nature of these projects – of accommodating the constraints, structures and priorities of the various national teams involved.

1.6 Complementarity of demand for R&D funding in Switzerland

FPs are addressed to researchers at all types of host institutions. The other programmes represented here show more distinct profiles as regards the distribution of subsidies to differents types of institutions (universities and FIT for the SNSF and COST; FIT and UAS for the CTI; companies for EUREKA). UAS, however, receive relatively few subsidies from FPs. They are largely funded by the CTI, with 35% of its subsidies going to these institutions.

Despite the opportunities offered by COST and EUREKA, FPs are cited by the companies surveyed as the only source of public funding for company R&D activities, which is true de facto given the budgets of the various programmes. From this viewpoint, the lack of national funding for company R&D, especially for SMEs, is perceived as a competitive disadvantage vis-à-vis foreign companies. It should be recalled that more than half (55%) of the European subsidies allocated to Swiss companies go to SMEs, the promotion of which is an integral part of the objectives of FPs.

As regards research themes (Table 3), all the programmes considered here, with the exception of the SNSF, are largely oriented towards the fields of mathematics, science and engineering. The SNSF shows the most balanced distribution among the three categories shown. It clearly represents the main source of research funding for humanities and social sciences in Switzerland.

The survey conducted in 2005 on behalf of the SER[14] indicated that 16% of participants in European projects had no other projects fi-

[13] Joint Technology Initiatives are partly funded by FP7, but they are established as distinct and diverse legal entities. In spite of the association agreement for FP7, Switzerland's participation in these initiatives is sometimes restricted by legal considerations and the lack of a legal basis for funding.
[14] SER, 2005, op. cit.

The various research funding programmes available at the national level are geared to different objectives (cf. the preceding section). Table 2 shows that they are also addressed to different target groups.

Table 2
Proportion of subsidies allocated to each type of host institution for the five main sources of direct public research funding in Switzerland

Type of participants [a]	FRP (average 2003-2006)	SNF (2007)	KTI (2007)	COST (2007) [d]	EUREKA
Universities	28%	66%	17%	33%	} 32%
FIT	34%	24%	41%	38%	
UAS	2%	2%	35%	4%	
Companies	26%	<1%	0% [c]	7%	63%
↳ *of which SMEs*	↳ *55%*	↳ [b] -	↳ [c] -	↳ *100%*	↳ *64%*
Others	11%	8%	7%	18%	4%

Table 3
Proportion of subsidies allocated to various research fields for the five main sources of direct public research funding in Switzerland

Research fields	FPs (average 2003–2006)	SNSF (2007)	CTI (2007)	COST (2007) [d]	EUREKA
Humanities and social sciences	7%	25%	13%	4%	0% [e]
Mathematics, science and engineering	59%	37%	67%	68%	80% [e]
Biology and medecine	23%	38%	21%	28%	20% [e]
Other	11%	–	–	–	–

Notes to Tables 2 and 3:
[a] Proportion of subsidies committed for researchers during the period under consideration. In the case of support for individuals, the host institution is recorded.
[b] Data not available.
[c] Funding of a project by the CTI requires the participation of at least one private partner in addition to partners from research institutions. Thus, 531 companies, including 414 SMEs (78%), were associated with projects financed by the CTI in 2007.
[d] Research only (federally funded).
[e] EUREKA research projects are not classified by research field, but by technology field. The figures given relate to the entire EUREKA network.

NB: The final version of the impact study to be published in 2012 will also include a comparison of the list of individual researchers based in Switzerland receiving funding from the FP7 "Ideas" programme and from the SNSF, in order to establish whether the same target group is reached (the two programmes have the same main objective of providing funding for researchers on the basis of project excellence) and whether there are links between these two programmes.

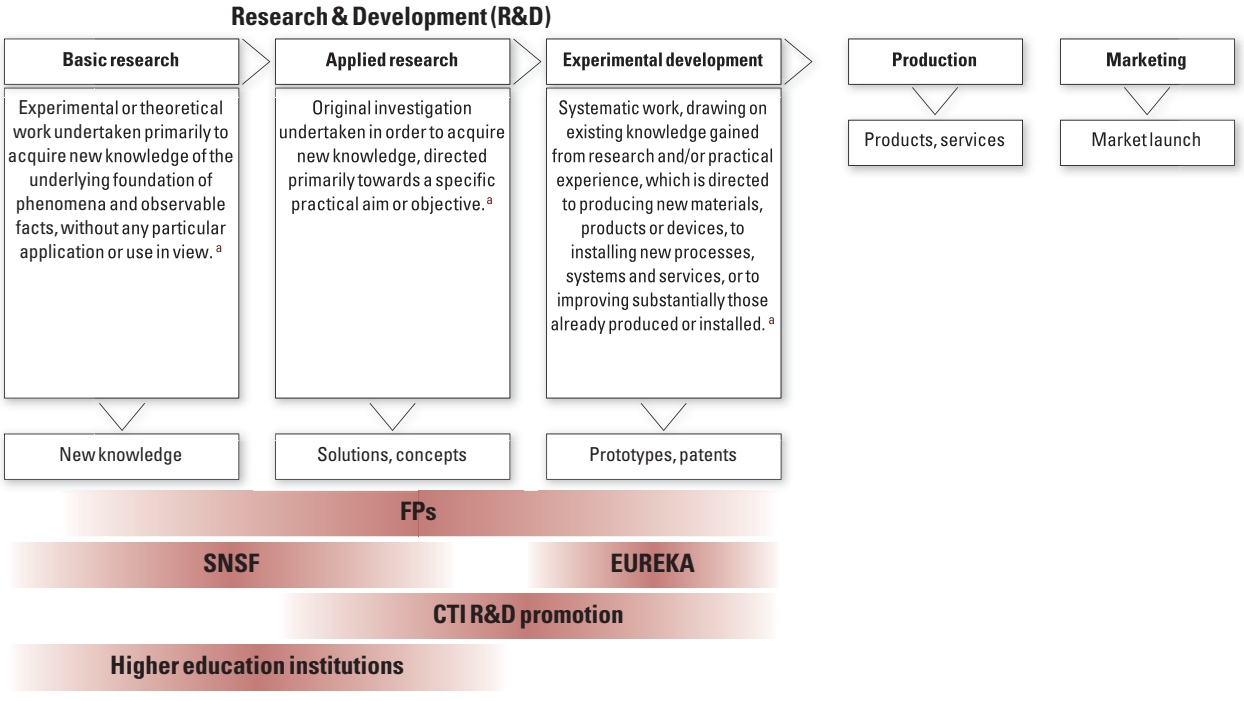
nanced by public funds. This suggests that even though FPs may be regarded as an additional source of funding, especially for higher education institutions, there is also a target group in Switzerland to which FPs are specifically addressed and for which they provide particular benefits (cf. also Section 3.5, p. 24). ■

2 Effects on the economy and employment

In the innovation chain, FPs provide funding for the entire process of R&D from basic research (since FP7, thanks to the "Ideas" programme) to experimental development, with an emphasis on applied research. They thus play a significant role in the innovation process. The production and marketing stages are not covered by FPs. Here, in particular, private capital comes into play, as well as support provided by the Innovation Promotion Agency CTI, especially to promote the establishment of companies.

The methodological problems attaching to the evaluation of effects (Annex B) mean that it is impossible for long-term impacts to be precisely attributed to Swiss participation in FPs. Today, despite active research efforts in this area, little is known about the mechanisms whereby investments in R&D and their immediate products interact with other aspects of the economy and socie-

Figure 2:
Swiss public funding in a simplified linear model of the innovation chain



[a] OECD (2002) Frascati Manual: Proposed Standard Practice for Surveys on Research and Experimental Development.

ty[15]. However, estimates or econometric models make it possible to foresee certain economic consequences of FPs. An OECD study[16] of 16 countries analysed for the period 1980–98 concludes that 1% more in public R&D generates 0.17% in productivity growth. This effect is larger in countries where the share of universities (as opposed to government labs) is higher, in countries where the share of defence is lower, and in countries which are intensive in business R&D. Another model used by the European Commission[17] predicts that, by 2030, European GDP would increase by 0.6% and that 400 000 jobs would be created (including 120 000 for researchers) if FP7 were to be pursued with annual funding growth of 3.9% until 2030. A series of other studies[18] cite increases of between EUR 0.40 and EUR 0.93 in private R&D investments for every EUR 1 of public R&D funding. It should be noted here that the EU R&D policy, of which FPs are the key element, is at the centre of the "Lisbon strategy", which aims, in particular, to make the EU the most competitive and dynamic knowledge-based economy in the world by 2010.

2.1 Profile of company participation in FPs and effects on the turnover of participating companies (indicators 2.1 and 2.2)

Company participation in FPs mainly involves SMEs (64% in FP6 and 60% in FP7). Although SMEs make up 99.6% of Swiss companies[19], and their participation in FPs is particularly encouraged, they are underrepresented here, which is explained by the fact that large companies account for two thirds of all R&D activities carried out in Swiss companies[20]. Given this proportion, the participation of SMEs is thus fairly high. A study of the impact of public research on innovation[21] demonstrated that companies participating in European projects were more active in R&D, more networked, more oriented towards international markets and showed higher patenting activity than average.

Under FP6, a total of 562 company participations in European projects were funded (i.e. an average of 140 per year). By comparison, in 2007,[22] the activities of the CTI enabled 531 companies, including 414 SMEs (78%), to take part in joint research projects with non-profit research institutions. Company participations in CTI projects are distinguished from those in European projects firstly by the fact that no funding is allocated to them by the CTI, and secondly by the different aims of the two programmes (cf. Sections 1.5 and 1.6, p. 14/16).

The sectors most frequently represented among the participating companies are manufacturing (45% of participations), scientific R&D (16%) and IT (7%). These three sectors are overrepresented in relation to the total population of Swiss companies (where they respectively make up 11%, 0.2% and 4%)[23]. This gives an indication of the sectors in which the impacts of FPs are likely to be most significant, and demonstrates the interest of the manufacturing sector: it may be concluded that FPs contribute to the development of products and services at a stage relatively close to commercialisation.

Data on how FPs affect the turnover of participating companies will not be available until 2012, but the survey conducted in 2005 by the SER[24] shows that 44% of the large companies participating in a European project as well as 64% of the SMEs expect or have already achieved an increase in their turnover as a result of participation. In addition, an evaluation[25] of 1200 projects under the BRITE-EURAM and Standards, Measurement and Testing programmes completed in the period 1996–2001 found that EUR 1000 m in FP funding generated EUR 1100 m in additional turnover for the companies concerned.

2.2 Direct growth in employment and establishment of companies (indicators 2.3 and 2.4)

European subsidies are mainly used to engage researchers active in various projects. This has the direct effect of creating or maintaining a certain number of jobs. The SER survey conducted in 2005[26] showed that each participation in a European project directly created about two jobs. The number of people (not full-time equivalents) who were employed in Switzerland thanks to FP5 can therefore be estimated at 3000, with the figure for FP6 being 4000. Around two thirds of these positions are for a limited term. The positive effect of FPs on employment is also confirmed by the evaluation of the impact of the BRITE-EURAM, Measurements and Testing, and Transport programmes: this showed that every EUR 1000 m invested in these programmes allowed 2700 new jobs to be created and 2300 threatened jobs to be safeguarded.

Over the longer term, these projects generate additional jobs through the companies which may be established as a result. It is estimated[27] that 22% of participations contribute to the establishment of a start-up or spin-off, which is equivalent to around 350 companies for FP5 and more than 400 for FP6.

The full 2012 study will also include a list and longitudinal follow-up of companies established on the basis of the results of a European project, specifically with regard to the number of employees.

15 Lane J., 2009, Assessing the Impact of Science Funding, Science, vol. 324
16 OECD, 2001, R&D and Productivity Growth: Panel Data Analysis of 16 OECD Countries, STI Working Paper 2001/3
17 European Commission, 2005, Impact Assessment and Ex Ante Evaluation. Annex to the Proposal for the Council and European Parliament decisions on the 7th Framework Programme (EC and Euratom), COM(2005) 119 final
18 v. Hyvärinen J. (TEKES, FI), 2006, "Impact analysis", presentation at the EU RTD Evaluation Network meeting, Helsinki
19 In 2008. Source: SFSO, Business census, 2009
20 Arvanitis S. et al. (on behalf of the State Secretariat for Economic Affairs SECO), 2007, Innovationsaktivitäten in der Schweizer Wirtschaft. Eine Analyse der Ergebnisse der Innovationserhebung 2005.
21 Polt W. et al., 2008, Innovation Impact Study, Final Report
22 OPET, 2007, *op. cit.*
23 In 2008. Source: SFSO, Business census, 2009
24 SER, 2005, *op. cit.*
25 European Commission, EVIMP – Evaluation and impact assessment of 2000 research projects completed between 1996 and 2001 in the fields of: Industrial and Materials Technologies (Brite-Euram) and Standards, Measurement and Testing (SMT)
26 SER, 2005, *op. cit.*
27 ibid.

2.3 Direct products of research (indicators 2.5 and 2.6)

As FPs cover the whole spectrum of R&D activities, the results of European projects are extremely diverse, ranging from the generation of new knowledge (in the case of the most fundamental results) to a patented prototype ready for marketing (in the case of the most tangible). With regard to tangible results, about 54% of participations in European projects[28] contribute directly to the development of marketable products and services, 48% lead to new industrial and scientific processes, 38% to new tools or machines, 37% to new infrastructures, and another 29% to new standards.

Among the Swiss researchers who provided information on the results of FP4 projects[29], 209 developed a product or service to a marketable stage and are seeking financial support in this direction (marketing agreement, licensing agreement, joint venture, manufacturing contract, request for venture capital or spin-off funding). This figure rose to 628 for Swiss participations in FP5.

Patents granted on the basis of European research are of particular importance as indications of future economic effects. Altogether, 29% of Swiss participants[30] reported having obtained a patent or expecting to obtain one within three years after the end of a project, which, if all the applications are successful, represents around 450 patents arising from participations in FP5 and more than 500 for FP6. However, the number of filings or grants reported to the European Commission as the result of an FP5 project (indicator 2.6) is 104, although this figure remains provisional. Here, no distinction is made between the various patent offices[31], which rules out international comparisons. However, the most recent data available on patent filings[32] indicates that a total of 2693 European patent applications and 1707 US patent applications were filed by Swiss researchers for 2003. Thus, although FPs account for a relatively low proportion of Swiss research funding, they make a significant contribution to the acquisition of patents by Swiss researchers.

Patents are only one way of protecting potentially marketable results. Other types of protection (e.g. copyright for software, registered trademarks, industrial secrecy, licensing, private contract) are employed three to four times more frequently[33] than patent filings for the results of European projects. ■

[28] ibid.
[29] CORDIS, database of results from FP4, FP5 and FP6, data retrieved on 20 May 2009
[30] SER, 2005, *op. cit.*
[31] In particular, the Swiss Federal Institute of Intellectual Property, European Patent Office, US Patent and Trademark Office, Japan Patent Office.
[32] OECD, 2007, Main Science and Technology Indicators (MSTI) database, STI/EAS Division, Paris
[33] CORDIS, database of results from FP4, FP5 and FP6, data retrieved on 20 May 2009.

3 Effects on scientific collaboration networks

FPs represent a means of overcoming the fragmentation of the European research system, not only through the mobility of researchers which they facilitate, but also thanks to the collaborative type of research projects which they promote. The vast majority of European projects involve a research consortium, comprising several teams from different member states or associated countries. This chapter is concerned with the influence of FPs on the creation of networks and on the integration of Swiss researchers into these networks.

Recent Finnish[34], Swedish[35] and British[36] studies show that for a clear majority of participants in European projects, the main advantage of participation is the development of networks and international collaboration. In Switzerland[37], 84% of participations strengthen existing research collaborations, and 87% permit the development of new collaborations. It has thus been demonstrated that, in the vast majority of cases, participation in European projects has positive effects on the networks of the researchers concerned.

3.1 International collaborations (indicator 3.1)

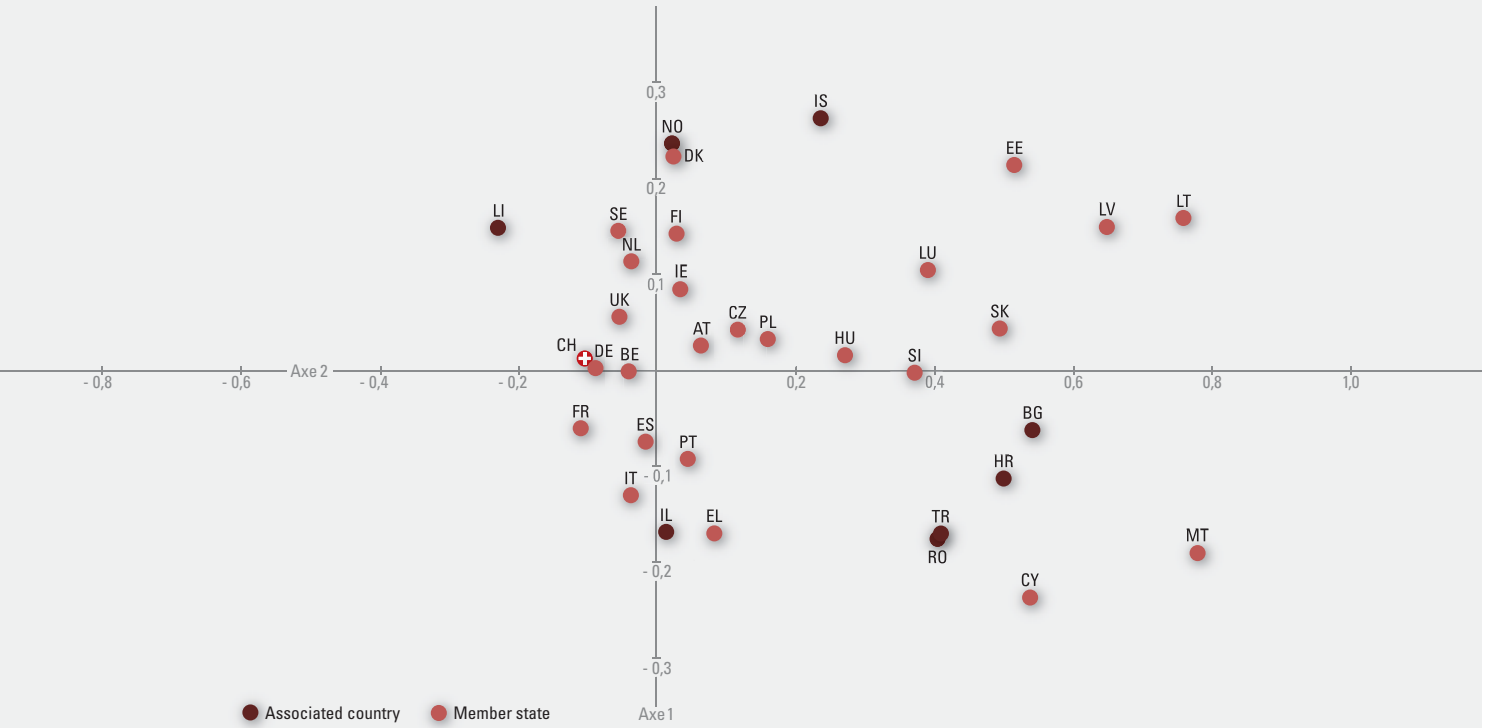
The first aspect of scientific collaboration to be considered is the main countries of origin for the partners of Swiss researchers participating in European projects. Half of these partners (or more precisely 51% for FP6 and 48% at the start of FP7) come exclusively from the four largest European countries (DE, FR, UK, IT). In this respect, Switzerland exhibits the behaviour of an average partner by European standards.

An evaluation of the intensity of international collaboration in FP6 – allowing for the size of individual countries – is shown in Figure 3[38]. This map is drawn up in such a way that the more intense the collaboration between two countries, the closer together they are positioned. At the same time, the more "specialised" a country's collaboration profile (characterised by close links with selected countries), the more distant the country is from the origin of the graph. This analysis reflects fairly accurately the geographical map of Europe, indicating that a large number of collaborations in FP6 involved neighbouring countries. In other words, geographical proximity significantly promotes collaborative affinities. As well as revealing certain groups of countries within which strong collaborative links exist (e.g. Western Europe, Baltic States, Southeastern Europe), the map shows that Switzerland is both highly integrated into the network of large Western European countries and open-minded in selecting the national origin of its partners.

Another sign of Swiss researchers' integration into the European system – an indirect effect of FPs – is their participation as experts in the evaluation of European projects. The Commission recruits from the entire body of European researchers those who

[34] TEKES, 2008, Finns in the EU 6th Framework Programme, Helsinki
[35] VINNOVA, 2008, Impacts of EU Framework Programmes in Sweden
[36] UK Office of Science and Technology, 2004, The Impact of the EU Framework Programmes in the UK
[37] SER, 2005, *op. cit.*
[38] SER, 2008, Switzerland's Participation in the 6th European Research Framework Programme – Facts and Figures. The map shows a correspondence factor analysis of the number of collaborative links between the various participating countries (principal normalisation; LI and DE were introduced as supplementary categories). One collaborative link between two countries is counted each time a team from each country participates in the same research project. The analysis makes it possible to compute distances between countries in such a way that two countries are closer together the greater the number of collaborative links between them, relative to the respective numbers of participations. The map is a two-dimensional projection of these distances, which correctly reproduces 57.3% of the distances.

Figure 3
Closeness of collaboration in FP6, plotted for member states and associated countries (correspondence analysis of collaborative links). The closer two countries are in the correspondence map, the more frequently they collaborated in FP6 projects.



are responsible for evaluating the quality of the proposals submitted; this evaluation determines which projects can be funded. During FP6, between 250 and 300[39] Swiss researchers fulfilled this role across all research priorities, but primarily in the fields of life sciences and information technology. In addition, a number of Advisory Groups were established to advise the European Commission on FP work programmes, strategy, objectives and priorities. While two (out of twelve) Advisory Groups for FP6 included members from a Swiss institution[40], Swiss researchers are currently serving on five of the fourteen Advisory Groups for FP7[41], which demonstrates that Switzerland's integration is also progressing at the structural level

3.2 Public-private collaborations and knowledge transfer (indicators 3.2 and 3.3)

As well as stipulating conditions concerning the diversity of national origin for partners in research consortiums, FPs also in most cases encourage the presence of both public research institutions and private companies in consortiums. Thus, a third of all research collaborations[42] between Swiss participants in European projects involve a higher education institution and a company. Overall, there were 273 public-private collaborations in FP6 (2003–2006), representing opportunities for the alignment of research agendas and the sharing of knowledge and experience between these two settings. Naturally, this figure does not include the much more numerous public-private collaborations with foreign institutions, but these cannot be reported precisely for lack of data. A study by the SER[43] indicated that these interactions produced real effects, since more than half of all participations lead to the strengthening of commercial partnerships and more than half permit the development of new commercial partnerships.

The requirements for collaboration between participants in research projects are supplemented by a variety of scientific exchange grants explicitly designed to promote the transfer of knowledge (ToK). These grants are available to institutions wishing to recruit experienced researchers to strengthen or develop research skills. The schemes known as Marie Curie Industry-Academia Strategic Partnerships (for FP6) and Marie Curie Industry-Academia Partnerships and Pathways (for FP7) exclu-

[39] A more accurate estimate is not possible on the basis of the data available.
[40] The Advisory Groups on Information Society Technologies and on Joint Space Strategy.
[41] In the areas of health, energy, transport, food and research for SMEs.
[42] A collaboration is counted each time two institutions participate in the same research project.
[43] SER, 2005, *op. cit.*

sively fund exchanges between academic and industrial institutions. During FP6, 21 Swiss researchers received ToK grants, including 8 exchanges between a public institution and a company. While this number may appear to be low in absolute terms, it actually represents 3.3% of the grants of this type available for FP6, and 5.2% for FP7, which is a high proportion of participation for Switzerland[44]. One of these scientific exchanges is featured in the "success stories" (Section 5.4, p. 32).

The cooperation between public and private institutions that results from exchanges of this type – "innovation cooperation" – is one of the three sources of technology and knowledge identified by the OECD[45], together with open information sources and acquisition of technology and knowledge (by direct purchase or by hiring expert employees). It thus represents an opportunity for companies, which also enables researchers with academic backgrounds to gain experience of industry and an understanding of its needs.

3.3 Mobility of researchers (indicator 3.4)

FPs offer a wide range of grants for exchanges or training designed to promote the mobility of researchers within Europe, and also contacts with third countries. Such exchanges enable the participants and host institutions to acquire skills from each other, as well as promoting intercultural dialogue and European integration. During FP6, 244 exchange or training grants were awarded to researchers at Swiss institutions, representing 3.0% of all the available grants. Unfortunately, the host institutions cannot be identified on the basis of existing data.

Clearly, the mobility of researchers is also promoted by the collaborative nature of other research projects, especially for purposes of coordination. Altogether, therefore, almost 70% of all participations in FPs contribute to exchanges of researchers[46] .

Analysis of the geographical distribution of exchanges makes it possible to measure the attractiveness of Switzerland as a destination for foreign researchers. During FP6, the inflow of researchers on intra European fellowships[47] to Switzerland put this country in sixth place among all member states and associated countries[48]. In terms of the net gain (difference between inflows and outflows of IEF researchers), Switzerland ranks in second place (net gain of +57) after the UK (+465). Switzerland is thus highly attractive for researchers from within Europe. For researchers from the rest of the world[49], the picture is less striking: Switzerland ranks equally with Ireland as the 11th most popular European host country.

3.4 Establishment and durability of networks (indicator 3.5)

The existence of networks of scientific collaboration helps, at the individual level, to integrate researchers into the wider community and, more broadly, to overcome the fragmentation of the European research system. However, the achievement of these two goals depends on the durability of networks. It is thus important to determine whether the networks established for the purposes of a European project survive and are still used after the end of the project.

According to the survey commissioned by the SER in 2005[50], 92% of collaborations with the main partner continue after the completion of a project. This is an example of a structural effect, persisting beyond the initial impetus provided by an FP. The survey also reveals that 59% of participants have already collaborated with the main partner prior to the start of a European project. European projects thus serve both to develop new partnerships and to consolidate existing ones.

[44] It should be recalled that Switzerland contributed 2.7% of the total budget for FP6.
[45] OECD, 2005, Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data, 3rd edition
[46] SER, 2005, *op. cit.*
[47] Marie Curie Intra-European Fellowships
[48] European Commission, DG Research, 2008, Statistical Annex of the Science, Technology and Competitiveness key figures report 2008/2009
[49] ibid., analysis of Marie Curie Incoming International Fellowships for FP6.
[50] SER, 2005, *op. cit.*

3.5 Access to other funding programmes (indicator 3.6)

The conduct or results of a research project sometimes make it possible to obtain funding from another source. This may be the case when a product or service reaches a more advanced stage of development, or when a project has facilitated the development of skills or partnerships. For this reason, one of the advantages of participation in a European project could be an increased likelihood of securing funding from another programme. As yet, little data is available on this subject, but it does indicate that participants frequently receive funding from other programmes: in 2005[51], 59% of participants in European projects were also participating in projects funded by the SNSF, 37% in CTI-funded projects, and 29% in COST actions (cf. Section 1.6, p. 18). This shows that the target groups of these programmes overlap. In the future, it should be investigated to what extent the various programmes are interlinked. ■

[51] *ibid*

4 Effects on the generation of knowledge and skills

Although the short-term objective of most European projects – as for any scientific activity – is to generate new knowledge, the output is difficult to measure. Today, the standard practice is to evaluate scientific production using bibliometric methods, but these are not very suitable for applied research (cf. Section 4.1 below). Another intangible effect of scientific activity is the acquisition of skills by researchers themselves. These skills relate to numerous areas, including project and people management and collaboration with other professions or cultures, as well as strictly scientific skills. Only the latter will be considered in this chapter.

4.1 Generation of knowledge and dissemination of results (indicators 4.1, 4.2 and 4.3)

Scientific findings are most frequently validated and communicated by publication in a peer-reviewed journal. To measure scientific activity by the number of publications is essentially to assume that all the activities of researchers lead to the writing of articles. However, the publication of results is not necessarily an objective of European projects. When the results are close to a commercial application, the researchers may indeed have an interest in keeping them secret or securing protection (cf. Section 2.3, p. 20). Nonetheless, the SER survey[52] showed that a publication in a scientific journal is achieved or expected for 88% of all participations in European projects. This is equivalent to around 1400 publications arising from Swiss participation in FP5 projects and about 1600 for FP6, i.e. an estimated 375 publications per year on average. By comparison, the number of scientific publications for all Swiss researchers was about 14 700 in 2004 and about 18 400 in 2006[53]. Direct comparison of these figures calls for a degree of caution, however, since different methods of counting are used, but it is clear that the impact of FPs on the Swiss production of scientific articles is not insignificant, given the relatively modest financial contribution of FPs to Swiss research as a whole.

For the reasons mentioned above, conventional bibliometric analysis is not a suitable method of measuring the productivity or scientific quality of researchers participating in European projects. One of the new features of FP7 is the creation of the European Research Council, designed to support basic research projects. The fact that these projects are at a greater distance from the market than typical European projects makes bibliometric methods more relevant for this programme. It will be possible to carry out analyses of this type as soon as sufficient numbers of publications have emerged from this programme – at the earliest in the full study to be published in 2012.

4.2 Training of young scientists (indicators 4.4 and 4.5)

Participation in a European project may lead to the award of an academic degree (Master's, doctorate, etc.). This is the case for researchers engaged in 48% of Swiss participations[54]. If this figure is extrapolated to all participations in FP5 and FP6, around 200 degrees are supported each year by participation in a Euro-

[52] SER, 2005, *op. cit.*
[53] SER, 2008, Analyse bibliométrique de la recherche scientifique en Suisse.
[54] SER, 2005, *op. cit.*

pean project. In 2006, more than 15 000 degrees were awarded by Swiss higher education institutions (diplomas/licentiates, Master's, doctorates, continuing education, DEA/DESS), including more than 3000 doctorates[55]. Here again, given that this is a collateral effect of European projects, the impact of FPs is quite substantial. More comprehensive data will be reported in the full study. In particular, this will include a breakdown of the different types of degrees awarded, so that comparisons can be made with the appropriate national figures for Switzerland.

A certain number of mobility grants offered under FPs are open to researchers with less than four years' experience. They are thus partly designed to train young scientists by providing experience at a foreign research institution. This opportunity was taken by 119 Swiss researchers in the course of FP6. The data currently available for FP7 show that just over a third of the recipients of these grants are women. This proportion – to be interpreted with caution, given the small size of the available sample – is equal to the European average[56], but slightly higher than the proportion of all female researchers in Switzerland (27%)[57]. Even though the promotion of scientific careers for women is among the objectives of the European Commission's research policy[58], it must be conceded that the effect of FPs in this area is very modest, at least for this category of researchers. The issue of gender will also be addressed in more detail in the 2012 study, when data has been collected on all participants in all types of FP projects. ■

[55] SFSO, 2009, Indicators for universities.
[56] European Commission, 2009, Second FP7 Monitoring Report.
[57] Data for 2004, SFSO, 2009, Indicators for science and technology.
[58] In 1999, the European Commission set itself the target of achieving at least 40% representation for women among Marie Curie fellows (European Commission, 1999, Communication "Women and Science: Mobilising women to enrich European research", COM(99)76, Brussels). This target was subsequently extended to cover "all levels in implementing and managing research programmes" (Council Resolution of 26 June 2001 on science and society and on women in science, 2001/C 199/01).

5 Impacts

The indicators presented in Chapters 1–4 are more concerned with the short-term effects of FPs than with their long-term impact. In spite of the methodological difficulties attaching to the precise evaluation of long-term impacts, this chapter seeks to provide a more qualitative account of these consequences, based on four different approaches. Firstly, FPs are built around political objectives (Section 5.1), which are restated in the work programmes (Section 5.2). These two elements provide an initial description of certain expected impacts. Secondly, FPs have an impact on institutions – especially in the higher education sector – that participate in a large number of projects, which is described in Section 5.3. Thirdly, various impacts can be deduced from an analysis of individual projects, as is done in the list of success stories given in Section 5.4. Finally, FPs have an impact on Switzerland's policy concerning research and the European Research Area, to which – as an associated country – it can make an active contribution in line with its needs (Section 5.5).

5.1 Expected long-term impacts of FP7

FPs, as specified in Art. 163ff. of the EC Treaty, pursue the objective of "strengthening the scientific and technological bases of Community industry and encouraging it to become more competitive at international level, while promoting all the research activities deemed necessary by virtue of other chapters of this Treaty". The focus of FPs is thus on international research, laying the foundations for an innovative European economy and at the same time providing direct benefits for society.

Research and innovation are among the key factors for long-term, sustainable growth. Against the background of decelerating growth in Europe, compared with other regions of the world, increased investments in these areas would appear to be indispensable if Europe is to be prepared to face the foreseeable economic and social challenges. Accordingly, FP7 – which is to run for 7 years (2007–2013) with a total budget of over EUR 50 bn – is the biggest framework programme to date, providing on average about 60% more funding per year than was available under FP6.

In addition to a thriving economy, human health, an intact environment and social stability are required for sustainable prosperity and quality of life. FPs are therefore also designed to help combat diseases, poverty and threats to the environment, such as climate change, soil, water and air pollution, declining biodiversity, overfishing and deforestation.

Until their fourth generation (1994–1998), FPs were primarily intended to generate new knowledge with the aim of increasing the capacity for innovation. Since FP5, without losing sight of the need for competitiveness, greater emphasis has also been placed on social and environmental aspects. There has been a sharper focus on addressing socially relevant problems. For example, since FP5, each project proposal has been required to include an explicit account of environmental goals. Thus, virtually all FP projects now contribute either directly or indirectly to environmental protection.

FP projects also increasingly serve as foundations for policy-making (cf. PRIME success story, p. 41). For instance, no fewer than 70 projects from the FP5 environment programme were explicitly referred to in European Commission position papers. The EU Directive on greenhouse gas emission allowance trading was also based on findings from FPs. Likewise, efforts to develop a European minimum wage policy can be directly traced to FP projects.

5.2 Research conducted and scientific results obtained or expected in FP7

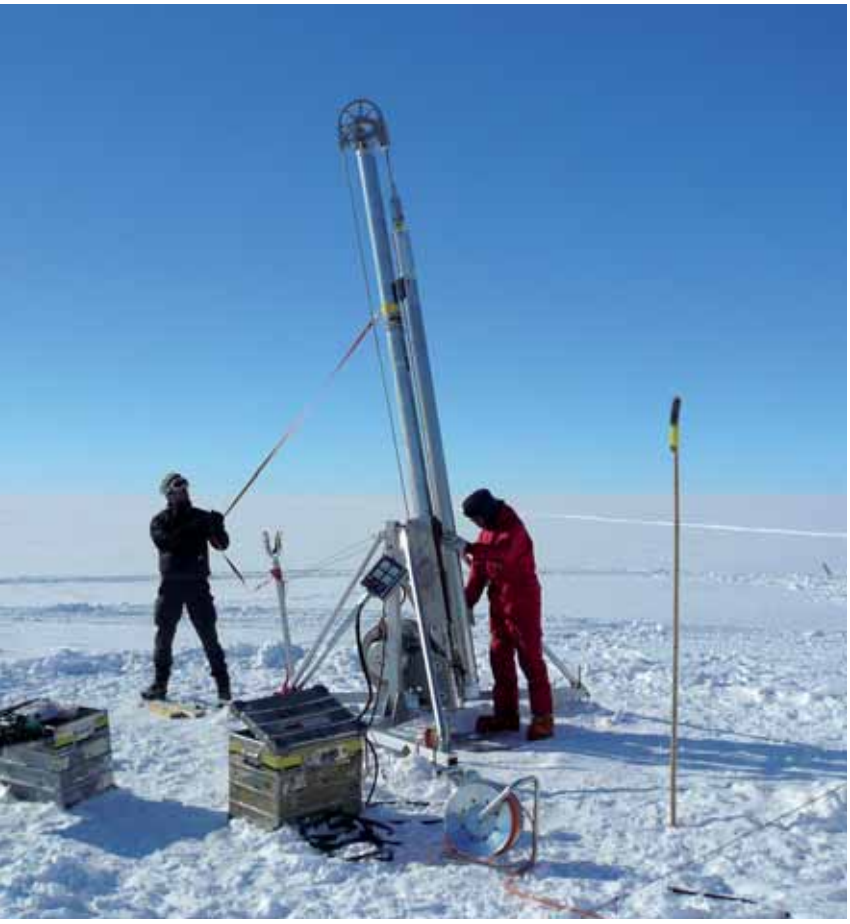
I. Cooperation

I.I. Health

The objective of the programme is to improve the health of European citizens and boost the competitiveness of health-related industries and businesses, as well as addressing global health issues and collaborating with developing countries. The priorities of the programme are in the following areas: translation of basic discoveries into clinical applications, development and validation of new therapies, methods of health promotion and prevention, including the promotion of healthy ageing, diagnostic tools and technologies, and sustainable healthcare systems.

I.II. Food, agriculture and fisheries, biotechnology

The aim of the programme is to build a European knowledge-based bio-economy by bringing together academia, industry and other stakeholders. New knowledge in the area of sustainable production and management of biological resources (microorganisms, plants, animals) is to provide a basis for new, sustainable, cost-effective and competitive products for agriculture, fisheries, the food, health and forestry sectors and related industries.



I.III. Information and communication technologies (ICT)

The objective of the programme is to strengthen Europe's science and technology base in the ICT field, to secure global leadership and to ensure that ICT progress is rapidly transformed into practical benefits. The programme is to focus on the following areas: nanoelectronics, photonics and integrated micro-/nanosystems; communication networks; embedded systems, computing and control; software, Grids, trust and dependability; learning and cognitive systems; interaction, visualisation, simulation and mixed realities.

I.IV. Nanosciences, nanotechnologies, materials and new production technologies

The programme is designed to facilitate the transformation of European industry from a resource-intensive to a knowledge-intensive one. In particular, support is to be provided for research projects aimed at improving growth, health, safety and environmental protection.

I.V. Energy

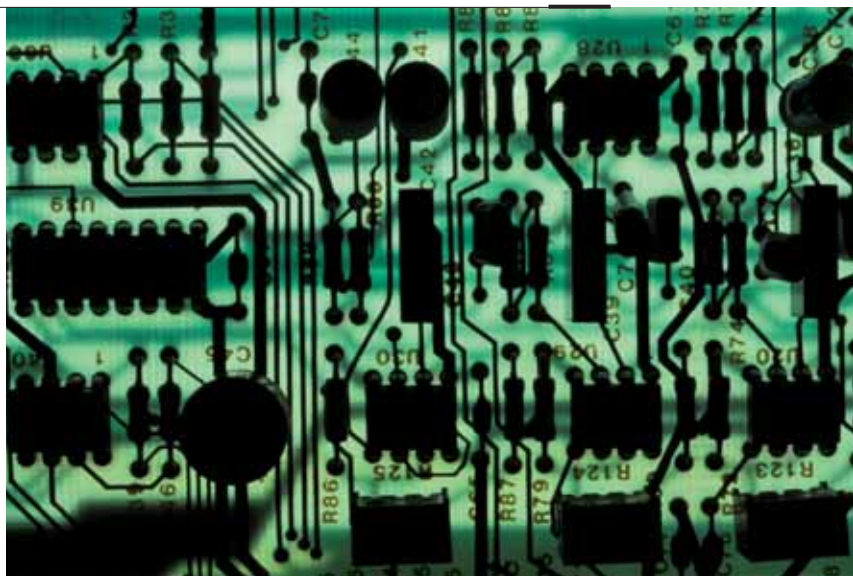
The objectives of the programme are to develop a more sustainable energy system with a diverse mix of sources, to increase energy efficiency so as to combat climate change and dependence on external supplies, and to boost the competitiveness of European energy companies. The programme will focus on the following areas: hydrogen and fuel cells; renewable electricity generation; renewable fuel production; renewables for heating and cooling; CO2 capture and storage technologies for zero-emission power generation; clean coal technologies; smart energy networks; energy efficiency and savings; knowledge for energy policy-making.

I.VI. Environment (including climate change)

The objective of the programme is to promote sustainable management of the environment and natural resources. Two approaches are to be pursued: 1) improving our knowledge of interactions between the climate, biosphere, ecosystems and human activities and 2) developing new environmentally-friendly technologies, tools and services. The programme will focus on the following areas: climate change, pollution and risks; sustainable management of resources; environmental technologies; earth observation and assessment tools for sustainable development.

I.VII. Transport (including aeronautics)

In the area of road, rail and waterborne transport, the programme has the following objectives: to increase the competitiveness of transport companies (for people and goods) and infrastructure operators; to improve the safety of transport and transport services; to reduce adverse environmental impacts of transport, including emissions and noise pollution; to increase the mobility of people and goods through a more balanced intermodal (road, rail, waterborne) transport system. In the aeronautics and air trans-



port field, research will cover technologies, services and the operation of all aspects of aviation, including aircraft, airports and air traffic systems.

I.VIII. Socio-economic sciences and the humanities

This programme aims to promote an in-depth, shared understanding of the complex and interrelated socio-economic challenges confronting Europe, in relation to growth, employment and competitiveness, social cohesion and sustainability, quality of life and global interdependence. It will focus on providing a better knowledge base for policy-making in the various sectors.

I.IX. Space

The aim of the programme is to support a European Space Programme focusing on applications such as "Global monitoring for environment and security" (GMES) and space foundations. The competitiveness of the European space industry is also to be strengthened. To achieve these objectives, two types of activities will be pursued: 1) Space-based applications serving European society (focusing on GMES) and 2) support for R&D to strengthen space foundations (space exploration, space transportation and technologies).

I.X. Security

The objective of the programme is to develop technologies and knowledge needed to ensure the security of citizens from threats such as terrorism and (organised) crime, natural disasters and industrial accidents, while respecting privacy and civil rights. The programme is also designed to establish networks of national and international actors and to stimulate coordination and cooperation.

II. Ideas (European Research Council/ERC)

The ERC is a body established by the European Commission to fund "frontier research". This concept reflects the new understanding of pioneering, visionary approaches, crossing the boundaries between basic and applied research, between conventional disciplines, and between science and technology. The ERC complements the thematic areas of the FP by funding "investigator-driven" research.

III. People (Marie Curie actions)

The programme is designed to strengthen human resources in European research by creating opportunities for researchers in the areas of training, mobility and career development. Actions are to be implemented under five headings: 1) initial training of researchers (especially doctoral students); 2) life-long training and career development (broadening the skills of experienced researchers); 3) industry-academia pathways and partnerships (stimulating intersectoral knowledge sharing and mobility); 4) international dimension (supporting the career development of EU researchers and collaboration with non-European researchers); 5) specific actions (additional measures, e.g. to remove obstacles to mobility and enhance the career perspectives of researchers in Europe).

IV. Capacities

The programme aims to enhance research and innovation capacities and ensure their optimal use. This objective is to be achieved via activities in the following areas: research infrastructures (support for new and existing infrastructures); research for the benefit of SMEs (providers of research services working for SMEs with inadequate innovation capacity); regions of knowledge (regional or cross-border research-driven clusters); research potential of the EU's "convergence regions" (developing research capacity in the enlarged EU); science in society (raising public awareness of science and technology); support for coherent development of research policies (coordination of research policies at regional, national and European level), international cooperation (scientific partnerships with selected non-EU countries).

5.3 Impact on research policies of participating institutions

The impact of FPs on the research policies of Swiss higher education institutions was studied at the five universities most active in FP6[59], the Federal Institutes of Technology and eight of the companies that were most active in FP6 (cf. Annex B, p. 59). The aspects studied, summarised below, include the promotion of specific fields of research, the establishment of support structures for project development and the utilisation of other external sources of public funding.

5.3.1 Impact on research policies of higher education institutions

Impact on R&D funding: In 2007, R&D costs accounted for about half of total expenditure at Swiss higher education institutions[60]. Most R&D activities are funded from the ordinary budget of these institutions. Table 4 below shows the proportion of R&D funding provided by FPs, the SNSF and the CTI at the in-

[59] Universitäten Basel, Bern, Genf, Lausanne und Zürich.
[60] BFS, 2009[61] VINNOVA, 2008, Impacts of EU Framework Programmes in Sweden

stitutions surveyed. The figures given are (sometimes rough) estimates, and they are therefore to be interpreted with the greatest caution.

The proportion of R&D funded by FPs is around a few per cent at the universities, reaching a maximum of 10% at the EPFL. This proportion is similar to the average recorded, for example, at Swedish universities – 4.5%[61]. By comparison, the CTI funds from one to several per cent of academic R&D, while the SNSF funds between 10% and 20%. From this perspective, FPs may be regarded as a significant additional source of third-party funding. At all the institutions (data not available for the Universities of Geneva and Zurich), financial contributions from FPs have tended to become increasingly substantial over the past few years. They also represent a growing proportion of all the third-party funding raised by higher education institutions. For this reason, among others (ease of access thanks to Switzerland's associated country status, funding of basic research by the ERC, visibility and prestige), FPs are explicitly identified as increasingly important strategic factors by certain institutions (UNIBAS, UNIGE, UZH, EPFL, ETHZ).

Table 4:
Funding of R&D activities

	Proportion of R&D activities funded by		
Institution	**FPs**	**SNSF**	**CTI**
UNIBAS [a]	2 %	not available	<1 %
UNIBE [b]	1 %	13 %	1 %
UNIGE [c]	3 %	20 %	not available
UNIL [d]	3 %	14 %	1 %
UZH [e]	2 %	9 %	<1 %
EPFL [f]	10 %	11 %	4 %
ETHZ [g]	6 %	13 %	3 %

[a] Average for 2004–2007, source: University of Basel, SFSO
[b] Average for 2004–2007, source: University of Bern
[c] 2008, source: University of Geneva
[d] Average for 2004–2008, source: University of Lausanne
[e] 2008, source: University of Zurich, SFSO
[f] Average for 2004–2008, source: EPFL
[g] Average for 2005–2008, source: ETHZ

Impact on direction of research: At all the higher education institutions, research priorities are set by researchers themselves. FPs thus do not directly influence the adoption or rejection of research fields (as confirmed by a study of Swedish universities[62], which also indicates that, for these institutions, the primary contribution of FPs is an increase in the diversity of funding sources and the provision of additional funding). However, encouragement to raise external funds, e.g. at the EPFL, may have an effect in setting the direction of research at the individual level. At the institutional level, FPs have made it possible to provide decisive support for and to develop certain research strengths or structures at UNIGE, UNIBAS and the ETHZ.

Impact on institutional mechanisms: At all the higher education institutions surveyed, FPs have led to structural changes designed to facilitate and encourage participation. In general, they have promoted the identification and clarification of various internal procedures. Specifically, several institutions (UNIBE, UZH, ETHZ) now provide financial support for regional Euresearch[63] offices already established at all university sites. Researchers also receive direct financial support for the development or launching of a European project (UNIL, UNIBE).

As regards structures, certain institutions (UNIBAS, UNIGE, UZH, EPFL, ETHZ) have set up internal support units for third-party fund-raising, project monitoring, reporting, or assisting researchers in the event of problems with a European project. As regards systems, accounting models have in some cases been adapted or are being developed (calculation of overheads, full costing), and document templates have been developed (UNIBAS, UNIBE, EPFL, ETHZ).

5.3.2 Impact on research policies of SMEs

The companies surveyed on the impact of FPs are listed in Annex B, p. 45; their situations are summarised below. They were selected on the basis of their particularly extensive participation in European projects; however, in view of the small sample size (4 companies), they are not to be taken as representative of the SMEs active in European research.

Impact on R&D funding: FPs fund between 15% and 40% of R&D activities at the companies surveyed. Certain companies (HTceramix, RAPP Trans) also cite other sources of public funding on the order of 15% to 20%. For these organisations, FPs thus represent a substantial, or even essential, source of funding.

Impact on direction of research: For all the companies surveyed, the direction of research activities is not dictated by the existence or otherwise of a relevant FP programme. Conversely, companies take advantage of this opportunity when it coincides with an internal research agenda. When agendas coincide, certain fields of activity are effectively supported not only by funding, but also by knowledge transfer, the creation or maintenance of a network (RAPP Trans), or improved knowledge of the competitive environment (HTceramix). The instruments provided by FPs are sometimes used for research projects involving relatively high risks, but potentially high returns (HTceramix).

[61] VINNOVA, 2008, Impacts of EU Framework Programmes in Sweden
[62] *ibid.*
[63] Euresearch is a federally mandated and funded information network designed to inform, advise and motivate Swiss researchers so as to promote Swiss participation in FPs.

Impact on institutional mechanisms: Only one of the companies surveyed (RAPP Trans) has established tools specifically dedicated to the preparation and management of European projects (guidelines, also used for other types of projects). However, beyond the formally structured framework, FPs promote institutional behaviour that is required for participation: engagement of external consultants for pre-evaluation of projects (HTceramix) and maintenance of contacts with the European Commission and with experts in the relevant field (RAPP Trans).

5.3.3 Impact on research policies of large companies

The companies surveyed on the impact of FPs are listed in Annex B, p. 45; their situations are summarised below.

Impact on R&D funding: At the large companies surveyed, the proportion of internal R&D activities funded by FPs is on the order of a few per cent, except in the cases of IBM and CSEM, where the figure reaches or slightly exceeds 10%. CSEM also uses the other research funding sources mentioned (SNSF, CTI, COST, EUREKA, amounting to 7–8%), but the contribution of these programmes is insignificant or even non-existent at all the other companies. FPs are frequently cited as programmes which are of substantial strategic interest, but whose influence is not likely to increase in the coming years (CSEM, IBM). The opportunity to participate in all the initiatives arising in connection with FPs (e. g. Joint Technology Initiatives/JTI, or the European Institute of Innovation and Technology/EIT) is described as decisive for certain fields of research (CSEM, IBM).

Impact on direction of research: The direction of research at the companies surveyed is not determined by FPs. Companies avail themselves of this funding option when it coincides with internal needs. At most, FPs are taken into consideration in the same way as external economic and industrial conditions (CSEM). However, several companies (ALSTOM, CSEM) maintain contacts with the European Commission with the aim of bringing the content of FP calls for proposals or work programmes into line with their own agenda. This subsequently enables them to benefit from adequate funding.

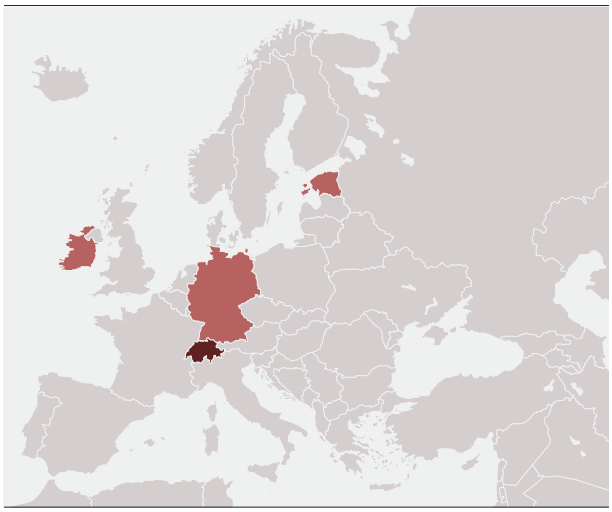
Impact on institutional mechanisms: Three of the four companies surveyed mention the establishment or adaptation of internal support structures. These take the form of a support group for financial aspects of European projects (Procter & Gamble) or more comprehensive structures (CSEM, IBM) covering all the phases of research projects (internal and external coordination, training, assistance with project preparation, administrative and legal support).

5.4 Success stories

FP6	Life sciences and health

SLIC – Biosensors in molecular diagnostics: nanotechnology for the analysis of species-specific microbial transcripts

Duration	Funding	
01.01.2005 – 31.12.2007 (3 years)	EUR 2.0 m	
Coordination	**Origin of partners**	
Ayanda Biosystems Parc scientifique EPFL CH-1015 Lausanne	Switzerland Germany Estonia Ireland	2 (Ayanda Biosystems, EPFL) 1 1 1
Swiss partner consulted		
Dr. Solomzi Makohliso, CEO Ayanda Biosystems Parc scientifique EPFL, CH-1015 Lausanne		



Regulation of human gene expression involves nucleic acids called microRNAs. Dysregulation is associated with a deficiency or excessive quantities of certain proteins, which may lead to disease, including several types of cancer. MicroRNAs can also play a role in the identification of pathogenic bacteria. The aim of the SLIC project was to develop and commercialise a compact device ("lab-on-a-chip") for the extraction, identification and analysis of microRNAs. This is the core technology of the start-up Ayanda Biosystems, based at the EPFL Science Park, which launched and coordinated the SLIC project.

Responsibility for coordination of the SLIC project enabled Ayanda Biosystems to align the research consortium's agenda with its own objectives. Thanks to the international, collaborative framework of the European project, it was possible to recruit an interdisciplinary team with highly specialised skills, not all of which can be found in Switzerland. At the same time, FPs have helped to maintain the network of Ayanda Biosystems, which is necessary to ensure that the technologies developed are at the cutting edge in a rapidly evolving field.

The development and commercialisation of "lab-on-a-chip" systems entails significant economic benefits.

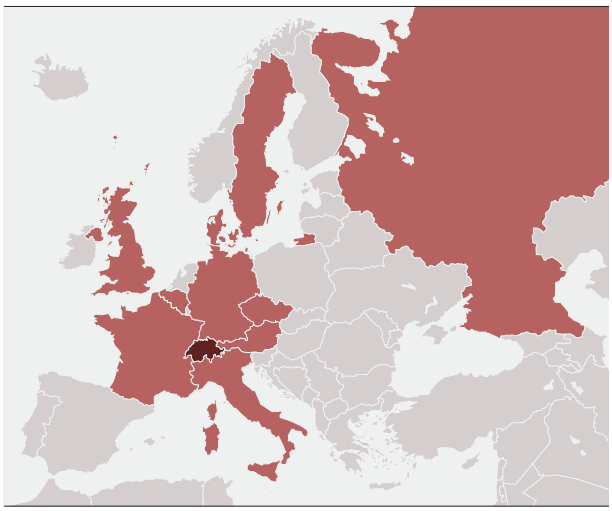
With the technology developed in the SLIC project, the time required for microRNA analysis has been reduced from a day to a quarter of an hour. This is associated with a considerable reduction in the costs of these procedures, which are now widely practised. This innovation entails significant benefits not only in economic terms (Ayanda Biosystems has been approached by the leading companies in the sector), but also for science and health (more rapid and less costly diagnostics).

Further information: www.ayanda-biosys.com

FP6	Information society technologies

SECOQC – Development of a global network for secure communication based on quantum cryptography

Duration	Funding	
01.04.2004 – 30.09.2008 ($4^1/_2$ years)	EUR 11.4 m	
Coordination	**Origin of partners**	
Austrian Institute of Technology (AT)	UK France Germany Austria Italy Switzerland Miscellaneous	8 7 6 6 4 3 (idQuantique, UNIGE, UNIL) 6, from 5 different countries
Swiss partner consulted		
Dr. Grégoire Ribordy, CEO *id Quantique* Chemin de la Marbrerie 3, CH-1227 Carouge		



Secure communication is an essential requirement for companies, public institutions and citizens. The encryption systems currently used are rendered vulnerable in particular by the continuing growth in computing power. Quantum cryptography, based on the quantum properties of light, ensures communica-

tion channels which are demonstrably inviolable. In 2008, the SECOQC project enabled the deployment of a telecommunication network based on quantum cryptography – a world first.

A world first: the project enabled the deployment of an inviolable telecommunication network.

No European – still less Swiss – group has expertise in all the technologies that are needed to establish a network of this kind. To succeed, the SECOQC project thus had to draw on the skills of 40 participants from 11 different countries. This provides id Quantique with visibility in all the partners' countries of origin. Integration into this type of network also makes it possible for Switzerland to maintain its position as a world leader in this field. The demonstration of the feasibility of an inviolable communication network heralds the birth of a new market, in which *id Quantique*, a Geneva university spin-off, is a global leader. The SECOQC project also led certain partners (including id Quantique) to jointly develop the first international standards in this new industry. In the wake of this project, a similar network was launched in Geneva in the second half of 2009, with a partnership involving the University of Geneva, CERN, *id Quantique*, Canton Geneva and the University of Applied Sciences Western Switzerland.

Further information: www.idquantique.com

7.FRP	*European Research Council* Starting Independent Researcher Grant in neurosciences
EMPATHICBRAIN – Plasticity of the empathic brain: structural and functional MRI Studies on the effect of empathy training on the human brain and prosocial behaviour	
Duration	Funding
01.09.2008 – 31.08.2013 (5 years)	EUR 1.5 m
Project management	
Prof. Tania Singer, Laboratory for Social and Neural Systems Research, University of Zurich, Blümlisalpstrasse 10, CH–8006 Zurich	

Social neuroscience studies the neural mechanisms underlying our capacity to understand our own and other people's feelings. At present, little is known about cerebral plasticity in the understanding of emotions and empathy, i.e. about the learning and modification of behaviour in this area. Of particular interest is the question to what extent empathy and prosocial behaviour can be trained in human adults. This is the issue addressed by the EMPATHICBRAIN project, led by Professor Singer (University of Zurich).

Leadership of a research group funded by a prestigious European Research Council grant ensures career development prospects and international visibility.

This wide-ranging programme calls for a longitudinal study sustained over many months, which was funded by a European Research Council (ERC) grant. This made it possible to adopt an interdisciplinary approach, utilising established methods from the fields of neuroscience, psychology and economics. This innovative and ambitious project also provides an opportunity to bring together Swiss expertise in these various areas: the project group led by Professor Singer is the only one in Switzerland seeking to clarify this question.

If conclusive results are obtained, this will be the first study to provide evidence of emotional brain plasticity in adults, representing a decisive step for research in the neurosciences. This research could have important implications for the implementation of scientifically validated training programmes designed to increase the capacity for cooperation and conflict resolution and to improve social communication – a growing need in schools and economic or political organisations. Treatment of social deficits in autistic or psychopathic subjects could also be improved. At the same time, this project will motivate more advanced studies in children, so as to identify critical periods in emotional and prosocial development and take these into account in educational programmes. Finally, Professor Singer's appointment as leader of the research group with a prestigious ERC grant and the innovative nature of the findings open up attractive career development prospects. This label also ensures a high level of international visibility for the research team, its findings and the University of Zurich.

Further information: www.socialbehavior.uzh.ch/singer.html

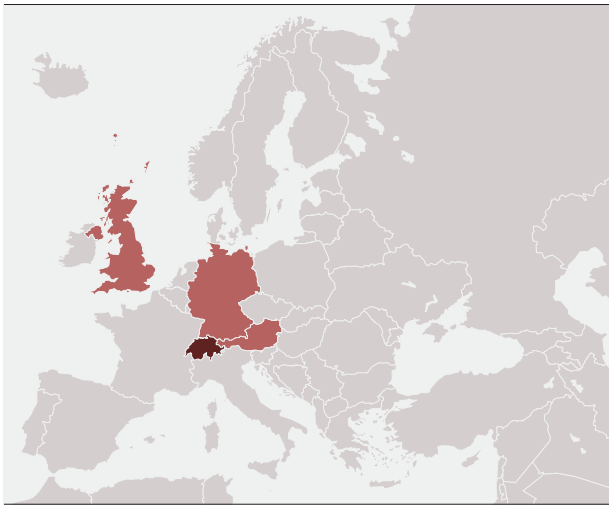
FP7	Marie Curie Fellowship *Industry-Academia Partnerships and Pathways*

CASOPT – Controlled component and assembly-level optimization of industrial devices

Duration	Funding	
01.04.2009 – 31.03.2013 (4 ans)	1,2 Mio. EUR	
Coordination	**Origin of partners**	
ABB Schweiz AG Corporate Research Segelhofstr. 1K CH-5405 Dättwil	Germany Austria UK Switzerland	1 1 1 1 (ABB)

Swiss partner consulted

Dr. Zoran Andjelic, Principal senior scientist ABB Schweiz AG, Corporate Research, Segelhofstrasse 1K, CH-5405 Dättwil



The aim of the CASOPT project is to produce a paradigm change in the design of complex electromagnetically-driven industrial products. State-of-the-art simulation-based design is to be replaced by optimization-based design. This new approach is the key to achieving the goals of miniaturization, reductions in the quantity of materials required and costs, and improvements in the energy efficiency of products. The research consortium brings together partners from industry and academia in a project based on knowledge transfer and coordinated by ABB.

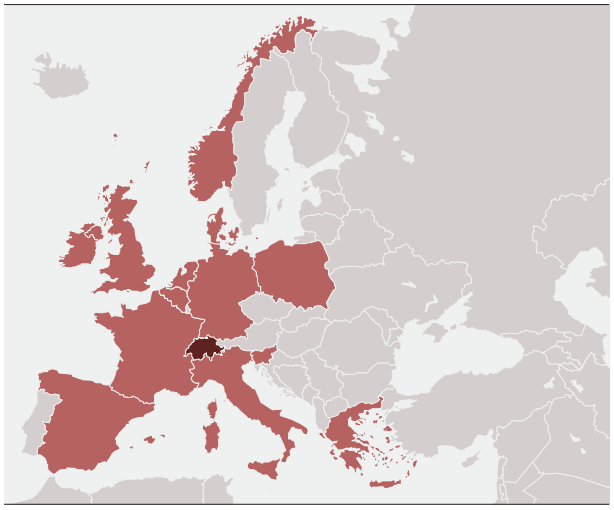
Synergies arise between the experience of private-sector and university institutions, and also between experienced researchers and others who are younger and highly motivated

As the CASOPT project is highly multidisciplinary, it was necessary to assemble a team of world-class experts in numerical analysis, simulation, optimization, geometric design and parallel computing. The realization of this project essentially relies on existing site competencies and knowledge transfer among the partners, with support from additionally recruited experts. Synergies arise between the experience of private-sector and university institutions, and also between experienced researchers and others who are younger and highly motivated. This offers them a unique opportunity to carry out research within a network, and also to develop other research ideas and projects.

In the short term, the results of the project will be used by ABB in the design of power transmission and distribution systems. For ABB, the leading power and automation technology group, it is essential to have cutting-edge technologies to enable the design of future products. The CASOPT project will make it possible to push the performance of products beyond current limits without adversely affecting their reliability or robustness. In addition, highly skilled young students, PhD students or post-docs participating in this type of project can be recruited by industrial partners. In the long term, the project could have a decisive impact on the evolution of industrial design concepts for many different sectors, but also for SMEs, whose product range is also covered.

Further information: www.casopt.com

FP7	Food quality and safety
ISAFRUIT – Increasing fruit consumption through a transdisciplinary approach leading to high quality produce from environmentally safe, sustainable methods	
Duration	Funding
01.01.2006 – 30.09.2010 (4½ y.)	13,8 Mio. EUR
Coordination	Origin of partners
University of Aarhus (DK)	Italy 11 France 7 Netherlands 7 Poland 6 Denmark 5 Spain 5 Switzerland 5 *
*(Agroscope, Andermatt Biocontrol AG, Fruit-Union Suisse, Hauert HBG Dünger AG, Research Institute of Organic Agriculture/FiBL)	
	Germany 4 Miscellaneous 11, from 8 different countries
Swiss partner consulted	
Dr Lukas Bertschinger, Deputy Director, Research Station Agroscope Changins-Wädenswil ACW, Schloss, P.O. Box 185, CH–8820 Wädenswil	



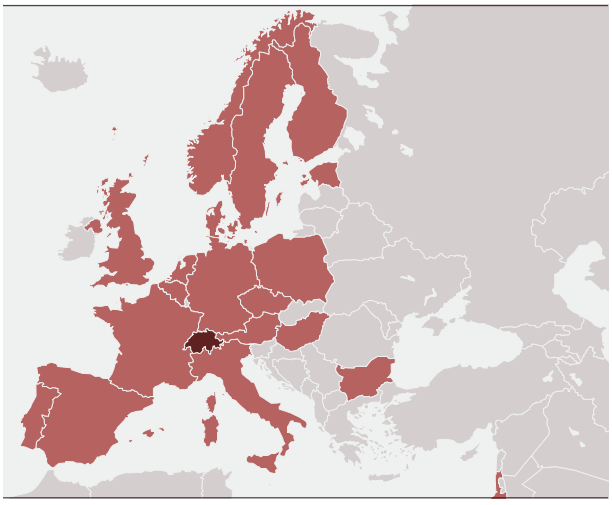
Many prevalent disorders, including obesity, are due to poor dietary habits. The ISAFRUIT project brings together industry, producers, and social and natural scientists with the objective of increasing fruit consumption in Europe. It addresses the total chain from production to consumption, studying not only consumers' attitudes to technologies for the production, treatment and storage of fruits but also the effects of fruit on health. In this project, the agricultural research station Agroscope is coordinating preharvest research efforts.

Switzerland benefits substantially from being integrated into the extensive network (comprising more than 60 institutions from 16 different countries) established to carry out this project. These links provide access to new knowledge which can be adapted to the Swiss environment, as well as to numerous national research systems. A project on this scale could not have succeeded in a purely national context since Switzerland lacks the expertise or capacity required for certain important areas of the project. In addition, an international team bringing together the leading specialists in each discipline can make more rapid progress than isolated national teams, and this cooperation paves the way for future research collaborations.

To date, Agroscope's research infrastructure has focused on production and preservation technologies. ISAFRUIT enables it to gain scientific expertise in the fields of consumption behaviour and the links between nutrition and health. Agroscope can thus better respond to the demand for sustainably produced, high-quality fruit, contributing to a modern, healthy diet. Apart from the scientific and technological implications of the project, the aim is also to strengthen the Swiss fruit sector by developing innovative, economically viable technologies and by making available to Swiss agriculture and industry knowledge which is at the disposal of potential foreign competitors.

Further information: www.isafruit.org

FP7	Citizens and governance in a knowledge-based society
PRIME – Policies for research and innovation in the move towards the European research area	
Coordination	Origin of partners
01.01.2004 – 30.09.2009 (6 years)	EUR 5.5 m
Coordination	Origin of partners
Ecole des Ponts/ENPC (FR)	France 8 UK 7 Italy 5 Switzerland 5 (listed below) Belgium 4 Norway 4 Netherlands 4 Miscellaneous 18, from 13 different countries
Swiss partners	
Universities of Bern, Geneva, Lausanne and Lugano (USI), EPFL	



The PRIME project brings together more than 40 teams with the aim of developing sciences and innovation policy studies, and

supporting public policy in this area. The project takes the form of a network of excellence, an instrument designed to overcome the fragmented nature of European research by promoting long-term infrastructures for research in specific fields.

When the project began, research in sciences and innovation policy was poorly developed and lacking in international connections. PRIME made it possible to attain a certain critical mass in this area and to encourage wider participation – by Swiss researchers in particular – in European programmes. The Swiss research community active in this area is too small to evolve on its own. From this perspective, this European collaboration is highly beneficial for the training of Swiss students or young researchers. At the same time, comparative research involving different countries is indispensable, and this is only possible within a European network.

PRIME has succeeded in bringing together the entire field of sciences and innovation policy studies across Europe and producing a number of significant advances concerning research funding mechanisms and university governance with a view to international excellence. The network has had and continues to have a major influence on European policy in this area, as demonstrated by the fact that PRIME members are well represented in most of the expert groups dealing with this topic at the European level. Since almost 10% of the Swiss federal budget is spent on education and research, Switzerland is particularly well-advised to take an active part in the development of European higher education and research policy, so as to ensure the country's long-term success..

Weitere Informationen: www.prime-noe.org

5.5 Political benefits of involvement in FPs for Switzerland

Participation in FPs is among the main priorities of Switzerland's science policy. Swiss researchers have been able to participate in FPs since 1987. Until 2003, this took place with limited rights and national funding. Various actions, especially in the area of researcher mobility, were not open to Switzerland. Nor could projects be led by Swiss researchers.

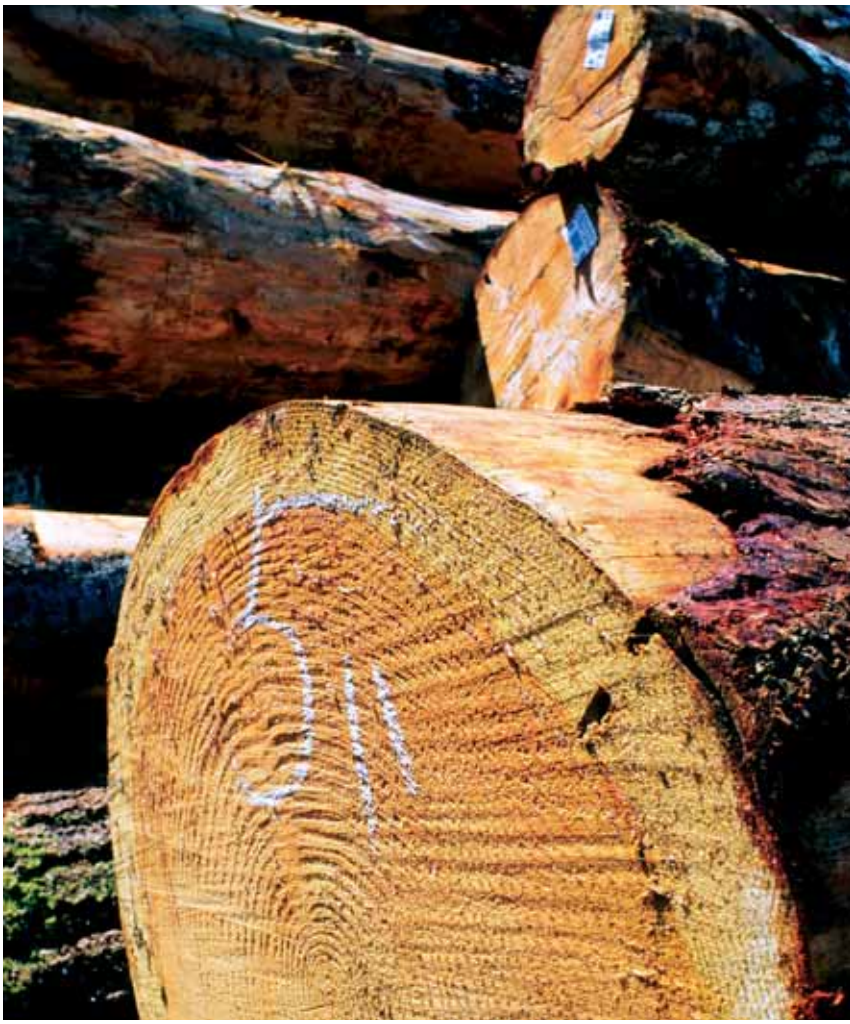
In 2004, the sectoral research agreement, part of the first series of bilateral accords between Switzerland and the EU, came into effect. Under this agreement, Swiss researchers were accorded the same rights and obligations as participants from EU countries. Since then, they have been eligible to participate in all programmes, have received funding directly from the European Commission, and are only required to submit applications and reports to this body.

The research agreement also offers significant benefits in terms of research policy. For example, under the agreement, Switzerland can sit on the FP management committees known as Programme Committees. These bodies, established for each thematic priority, oversee the conduct of programmes, define the details of calls for proposals (in cooperation with the European Commission) and approve the funding of projects that get through the evaluation process successfully. Thanks to the research agreement, Switzerland can also attend and contribute to meetings of the Scientific and Technical Research Committee (CREST), which advises the European Commission and the Council of the European Union on all political and strategic questions relating to research. Since it became an associated country, Switzerland has also been represented on the Board of Governors of the European Commission Joint Research Centre. Through these channels, Switzerland is able to have a say in the implementation of the current FP and in the development of future generations of FPs and of the European Research Area, and to pursue matters of interest to Switzerland as a research location. The research agreement also granted Switzerland privileged access to information which was not available while it was participating as a third country. ■

Further information on Switzerland's participation in European FPs

- Evaluation der schweizerischen Beteiligung am 5. und 6. Forschungsrahmenprogramm der Europäischen Union sowie des Informatiosnetzwerkes Euresearch (includes English summary), SER, 2005
- Switzerland's Participation in the 6th European Research Framework Programme – Facts and Figures, SER, 2008
- Switzerland's Participation in the 7th European Research Framework Programme, Stocktaking Report 2007–2008. Facts and Figures, SER, 2009

All these publications can be ordered from the SER or downloaded from the SER website: www.sbf.admin.ch/htm/dokumentation/publikationen_en.html



Annex A List of indicators

Presentation of indicators

No. of indicator (cf. Table 5, p. 48). The number and designation are greyed out when measurement of the indicator will only be available after data has been collected from participants, in the report scheduled for 2012.

Level of indicator (cf. Annex B, p. 45)

Expected impact(s) of the effect measured (cf. Introduction, p. 12)

2.6 Patents

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Result	Social welfare and security
Impact	Development of knowledge and communication

Definition
Number of patent applications filed or patents granted as a result of participation in a European project.

Definition of indicator

Period	Measurement
FP4 (1995–1998)	67
FP5 (1999–2002)	104
FP6 a (2003–2006)	7

Measurement(s). Greyed out data indicates that values are provisional and may change over time (programme not completed, time lag between cause and measurement of effect).

1. Effects on support for research

1.1 Financial returns

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Total amount of subsidies received by Swiss participants (excluding international organisations) for FP4–FP7.

Period	Financialreturn	Swiss contribution [c]
FP3 (1991–1994)	CHF 126,8 m	CHF 126,8 m
FP4 (1995 – 1998)	CHF 368,7 m	CHF 368,7 m
FP5 (1999 – 2002)	CHF 473,7 m	CHF 473,7 m
FP6[a] (2003 – 2006)	CHF 794,5 m	CHF 775,3 m
FP7 [a, b] (2007 – 2013) (as of 25 February 2009)	CHF 415,7 m	CHF 474,8 m

Source: European Commission, SER

[a] The amounts relating to FP6 (2003–2006) and FP7 (2007–2013) refer to subsidies committed, not those actually received by researchers; no information on the latter was supplied to us by the Commission.

[b] There is always a certain time lag between the official start of an FP and publication of the first subsidies committed; this explains why, at the time of the interim assessment, the Swiss contribution exceeds the financial return. The excellent success rate for Swiss proposals suggests that the financial return for FP7 will be even better than for FP6.

[c] Excluding the INTAS contribution (International Association for the promotion of co-operation with scientists from the New Independent States of the former Soviet Union) for FP4–FP6.

1.2 Coefficient of financial return

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
The proportion of subsidies awarded to Swiss researchers divided by Switzerland's relative contribution to the funding of the FP.

Period	Measurement
FP6 (2003 – 2006)	114 %
FP7 (2007 – 2013) (estimation as of 8 October)	145 %

Source: European Commission, SER

1.3 Leverage

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
The difference between the total cost of research carried out by Swiss participants in all the projects of an FP and the total amount of subsidies granted for these participations (i.e. expenses covered by participants themselves).

Period	Measurement
FP4 (1995 – 1998)	CHF 57,1 m
FP5 (1999 – 2002)	CHF 74,5 m
FP6 (2003 – 2006)	CHF 287,1 m
FP7 (2007 – 2013) (as of 25 February 2009)	CHF 128,7 m

Source: European Commission, SER

Note:
For FP4 and FP5, the totals are underestimated, as the sums requested by participants do not cover the actual project costs, but already exclude costs not covered by the FPs. For FP6 and FP7, the totals are also underestimated since the total cost of Swiss participations is not yet known (data lacking in the database).

1.4 Additionality

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
The number and proportion of research projects that would not have been carried out if European funding had not been granted.

2. Effects on the economy and employment

2.1 Profile of company participation in FPs

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
a) Number of participations by size of company (SMEs or industrial enterprises)
b) Proportion of company participations by economic sector

Period	Measurement	
a) FP6 (2003 – 2006)	SMEs: 358 (64%)/Industrial enterprises: 204 (36%)	
FP7 (2007 – 2013) as of 25 February 2009	SMEs: 119 (60%)/Industrial enterprises: 80 (40%)	
b) FP7 (2007 – 2013) as of 25 February 2009	1. Manufacturing	45 %
	2. Scientific R&D	16 %
	3. IT	7 %
	4. Post and telecommunications	4 %
	5. Education	3 %
	6. Transport and storage	3 %
	7. Production and distribution of water and energy	2 %
	8. Health and social activities	1 %
	9. Wholesale/retail trade, repairs	1 %
	10. Financial services	1 %
	11. Agriculture, hunting and forestry	<1 %
	12. Cultural, sporting and leisure activities	<1 %
	13. Recycling	<1 %
	14. Other/not classified	16 %

Source: European Commission, SER

Note:
Data relating to indicator 2.1b), taken from the database of FP7 project proposals, is provided by researchers themselves and is not verified. It is therefore to be treated with the appropriate caution. The improvements planned for the collection of data by the European Commission should in future ensure the availability of fuller and better-quality data.

2.2 Direct increase in turnover

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Additional turnover expected by companies as a result of participation in a European project.

2.3 Direct growth in employment

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Net increase in the number of people employed in organisations as a result of participation in a European project (full-time equivalents, by sex).

2.4 Establishment of companies

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Number of spin-offs or start-ups established as a result of participation in a European project.

2.5 Direct products of research

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Number of results of European research projects, by stage of development process.

Period	Measurement	
FP4 (1995–1998)	1. Scientific or technological knowledge (basic research)	89
	2. Technical plans, methods, standards	6
	3. Software	3
	4. Preliminary design, feasibility study	54
	5. Intermediate design, research phase	46
	6. Experimental development (laboratory prototype)	85
	7. Prototype ready for testing	38
	8. Test results available	37
	9. Other	85
FP5 (1999 – 2002)	1. Scientific or technological knowledge (basic research)	599
	2. Technical plans, methods, standards	162
	3. Software	151
	4. Preliminary design, feasibility study	–
	5. Intermediate design, research phase	1
	6. Experimental development (laboratory prototype)	142
	7. Prototype ready for testing	188
	8. Test results available	231
	9. Other	56
FP6 (2003 – 2006)	1. Scientific or technological knowledge (basic research)	3
	2. Technical plans, methods, standards	–
	3. Software	2
	4. Preliminary design, feasibility study	–
	5. Intermediate design, research phase	–
	6. Experimental development (laboratory prototype)	6
	7. Prototype ready for testing	2
	8. Test results available	5
	9. Other	1

Source: CORDIS

Note:
The number of results is underestimated by this indicator, on account of the time required between the end of a project and the appearance of a result. Thus, even though the last FP4 project with Swiss participation was completed in 2004, the number of FP4 projects generating results which were reported to the European Commission trebled between 2008 and 2009.

2.6 Patents

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Number of patent applications filed or patents granted as a result of participation in a European project.

Period	Measurement
FP4 (1995 – 1998)	67
FP5 (1999 – 2002)	104
FP6 (2003 – 2006)	7

Source: CORDIS

Note:
1. The number of patents is underestimated by this indicator, on account of the time required between the end of a project and the filing of a patent application or the award of a patent. Thus, even though the last FP4 project with Swiss participation was completed in 2004, the number of FP4 projects generating results which were reported to the European Commission trebled between 2008 and 2009.
2. No distinction is made between the various offices with which patent applications were filed (in particular, the Swiss Federal Institute of Intellectual Property and the European, US or Japan Patent Office).

3. Effects on scientific collaboration networks

3.1 International collaborations

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
National origin of partners for FP projects with Swiss participation.

Period	Measurement	
FP6 (2003 – 2006)	DE	16 %
	FR	12 %
	UK	12 %
	IT	9 %
	ES	6 %
	Other	**45 %**
	Total	100 %
		(20899 partners)
FP7 (2007 – 2013) as of 25 February 2009	DE	16 %
	UK	11 %
	FR	10 %
	IT	10 %
	ES	6 %
	Other	**47 %**
	Total	100 %
		(5467 partners)

Source: European Commission, SER

3.2 Public-private collaborations

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Number of research collaborations between Swiss higher education institutions (universities, institutions of the ETH Domain and universities of applied sciences) and Swiss companies.

One collaboration between two institutions is counted each time a partner from each institution is represented in the same research consortium.

Period	Financial return	
FP6 (2003 – 2006)	273	(33 %)
	Total	**831 (100 %)**
FP7 (2007 – 2013) as of 25 February 2009	91	(34 %)
	Total	**270 (100 %)**

Source: European Commission, SER

3.3 Knowledge transfer

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Number of Marie Curie grants awarded to Swiss researchers for knowledge transfer exchanges.

Period	Measurement
FP6 (2003 – 2006)	21[a] (including 8 public-private partnerships[b])
FP7 (2007 – 2013) As of 25 February 2009	9 (public-private partnerships[c])

Source: European Commission, SER

[a] Marie Curie Host Fellowships for the Transfer of Knowledge (TOK)

[b] Marie Curie Industry-Academia Strategic Partnership (TOK-IAP)

[c] Marie Curie Industry-Academia Partnerships and Pathways (IAPP)

3.4 Exchanges of researchers

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Number of grants for exchanges or training of researchers from a Swiss institution (Marie Curie actions)
The countries of origin and destination for exchanges will be known for FP7 after a survey of participants; the following indicators will be measured and published in subsequent studies:
- Number of outgoing fellowships from Swiss institutions, by country of destination
- Number of incoming fellowships to Swiss institutions, by country of origin

Period	Measurement	
FP6 (2003 – 2006)	2003	–
	2004	42
	2005	51
	2006	98
	2007	53
	Total	**244**
FP7 (2007 – 2013) as of 25 February 2009	2007	–
	2008	67
	2009	7

Source: European Commission, SER

3.5 Establishment and durability of networks

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Number of research consortiums established in the absence of previous collaborations between the main partners
Number of research consortiums continuing a collaboration (between at least two of the partners) after the end of a European project (pursuing research in the same field, setting up a company, other form of collaboration).

3.6 Links between funding programmes

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	Development of knowledge and communication

Definition
Number of participations in European projects which have helped to secure funding from another public research funding programme (SNSF, CTI, COST, EUREKA)
Number of participations in research projects funded by other programmes (SNSF, CTI, COST, EUREKA) which have helped to obtain European subsidies.

4. Effects on the generation of knowledge and skills

4.1 Scientific publications

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	**Development of knowledge and communication**

Definition
Number of peer-reviewed scientific publications relating to a European project (FP7 "Ideas" programme only).

4.2 Oral communications

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	**Development of knowledge and communication**

Definition
Number of oral communications (specialised scientific lectures, public lectures, courses, etc.) relating to a European project.

4.3 Other publications

Level	Expected Impact
Input	Growth, competitiveness and employment
Output	Sustainable development
Results	Social welfare and security
Impact	**Development of knowledge and communication**

Definition
Number of publications relating to a European project not published in a peer-reviewed journal or book (publication in other journals or books, on websites, in videos, course materials, etc.).

4.4 Degrees

Level	Expected Impact
Input	**Growth, competitiveness and employment**
Output	Sustainable development
Results	Social welfare and security
Impact	**Development of knowledge and communication**

Definition
Number of doctorates, Master's or other degrees taken with support from a European project, by sex.

4.5 Exchanges for young scientists

Level	Expected Impact
Input	**Growth, competitiveness and employment**
Output	Sustainable development
Results	Social welfare and security
Impact	**Development of knowledge and communication**

Definition
Number of exchanges and visits for young scientists (Marie Curie actions open to researchers with less than four years' experience)[a], by sex.

Period	Measurement		
FP6 (2003 – 2006)	2003		–
	2004		35
	2005		13
	2006		50
	2007		21
	Total		**119**
FP7 (2007 – 2013) as of 25 February 2009		**Women**	**Men**
	2007	–	–
	2008	12	20
	2009	1	3
	Total	**13**	**23**

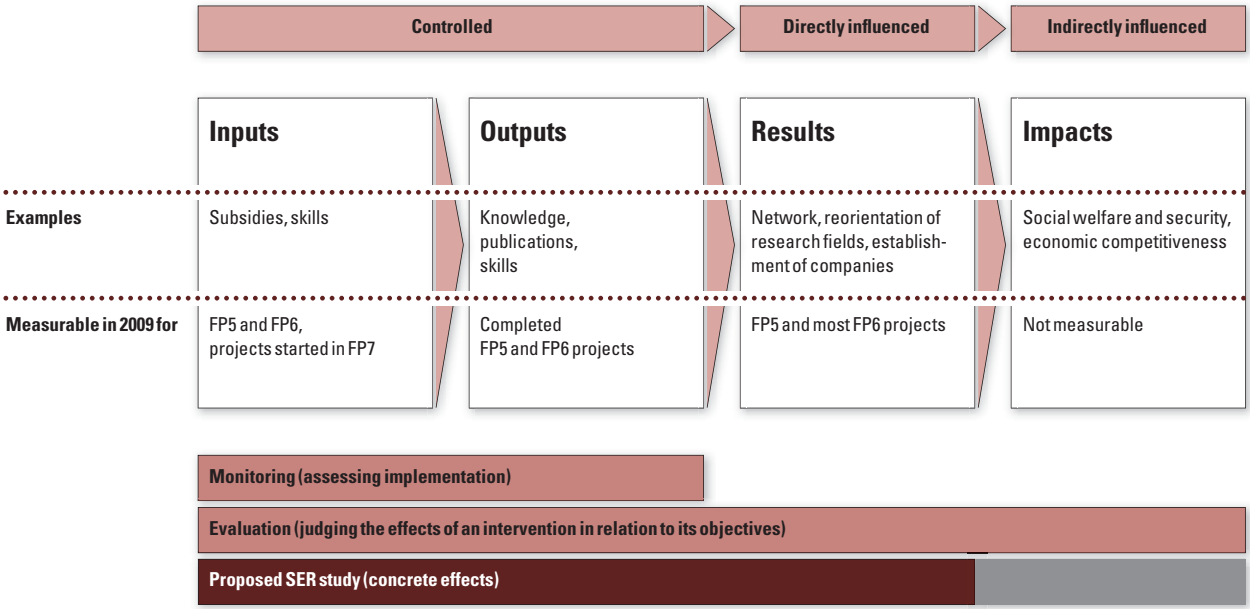
Source: European Commission, SER

[a] For FP6: Research Training Networks, Early Stage Research Training, Conferences and Training Courses, no data available on sex of participants
For FP7: *Initial Training of Researchers, Industry-Academia Partnerships and Pathways, International Research Staff Exchange Scheme*

Annex B Methodological notes

Outputs/results/impacts

In the literature on the effects of R&D activities, distinctions are frequently drawn between outputs, results and impacts, without, however, the boundaries between these different concepts being clearly defined. The distinction relates both to the time elapsing between the conduct of the research and the effect, and to the extent of the effect (within the scientific community, society, ...). A synthesis of the literature existing on this subject[64] yields the following scheme:



[64] For example:
- European Commission, Evaluating EU Activities — A practical guide for the Commission services, OPOCE, 2004;
- Arnold E. und K. Balázs, 1998, Methods in the Evaluation of Publicly Funded Basic Research. A Review for OECD, Technopolis;
- Hyvärinen J. (TEKES, FI), 2006, «Impact analysis», Presentation to the EU RTD Evaluation Network, Helsinki.

Outputs are the immediate, direct products of research (e.g. process developed, publication), results are the medium-term effects of research activities (which may be less tangible, e.g. a decision to invest in the development of a new product), and impacts arise from the interaction between research and the social, economic and cultural environment (e.g. the development of mobile telecommunications following the development of the GSM standard). Impacts are thus indirect, long-term effects.

In 2009, we can expect to be able to observe the outputs of all completed FP projects and some results from FP5 and FP6. Information on FP7 is limited to (essentially financial) inputs for projects already started. Significant methodological problems (see below) prevent measurement of most of the long-term effects of FPs, which are – paradoxically – the effects for the sake of which the programmes have been launched.

Measuring effects: methodological problems

Several authors[65] emphasise the gap existing between, on the one hand, decision-makers anxious to obtain quantifiable estimates of the results of a policy and of the return on investment in a particular area and, on the other hand, the reality of research which produces essentially intangible and non-quantifiable results, such as knowledge, networks or enhanced skills. Thus, it is believed, for example, that only 5–10% of FP projects – despite being oriented towards applied research – lead directly to commercial products within a year or two of completion. Many contribute to the subsequent production of products, processes or services, but often many years later, via a multitude of indirect routes and only after being complemented by the results of numerous other research projects.

More specifically, efforts to measure the impact of research programmes in Switzerland come up against the following main difficulties [66]:

1 **Problem of attribution:** It may be difficult to attribute results/impacts to a specific public intervention. According to the linear model of innovation, basic research produces a flow of theories and discoveries that are refined through applied research, tested in the development process, and finally commercialised as industrial innovations[67]. However, this model is rejected as too simplistic by more recent theories[68]. Recent studies reveal a much more complex scheme of knowledge creation, transfer and use; the term "ecology of innovation" is now preferred[69]. In most cases, impacts are due to a number of different factors or agents operating simultaneously and in an increasingly complicated manner over the long term, so that even the theoretical possibility of attributing an impact to a research programme is now denied[70]. The problem is aggravated by the international nature of FPs – and scientific collaborations in general – which makes it difficult to attribute domestic impacts to domestic investments[71].
2 **Problem of timing:** There is a considerable time lag – several years or even decades[72] – between inputs/outputs and results/

65 For example: EURAB, 2007, EURAB Recommendations on Ex Post Impact Assessment, EURAB Note 07.015, pp. 4–5.
66 European Court of Auditors, 2007, Special report No. 9/2007 concerning 'Evaluating the EU Research and Technological Development (RTD) framework programmes – could the Commission's approach be improved?', Official Journal of the European Union, C 26, 30.1.2008, p. 23
67 PREST, 2002, Assessing the Socio-economic Impacts of the Framework Programme, University of Manchester, S. 71
68 Rosenberg N., 1994, Exploring the Black Box, Cambridge, S. 145.
69 Lane J., 2009, Assessing the Impact of Science Funding, Science, vol. 324.
70 *«Macro Impact is very likely to be lost in the noise of effects arising from other inputs for RTD and beyond.»* (Georghiou L., Bach L., 1998, The Nature and Scope of RTD Impact Measurement, Brussels)
71 Office of Science and innovation (UK), 2007, Measuring economic Impacts of investment in the research base and innovation – a new framework for measurement, URN 07/1057
72 Lane J., *op. cit.*

impacts. For policymakers, there is also a long interval between the approval of a public research intervention and the possibility of observing its effects. For example, FP6 covered the period 2003–2006. The last FP6 projects began at the end of 2007 and run for an average of 3.5 years. This means it will be necessary to wait until the end of 2010 for most of these projects to be completed, and another three years for results to be observable (products, patents, ...). Impacts will emerge in the even longer term. FP7 will therefore be over before the impacts of FP6 are observable.

3 **Problem of scale:** However significant FPs may be in terms of direct federal contributions to R&D (ranking in second place after the Swiss National Science Foundation), this source of funding only represents around 1.5% of total R&D expenditures in Switzerland. The effects of this public intervention are thus drowned out by all the other influences.

In the shorter term, measurements are possible, and empirical research[73] provides evidence of certain benefits arising from public funding of research: an increase in knowledge, new instruments and methodologies, skills, access to networks of experts and information, resolution of complex technological problems, start-ups, access to research infrastructures. Collaboration networks appear to be necessary to attain the economic capacity to generate the knowledge required by businesses. Among scientists, too, networks permit discussion, sharing of prepublication material, lectures and other bilateral exchanges, providing privileged, rapid access to new knowledge.

In summary, outputs/results are amenable to measurement, whereas impacts are not. Obviously, the objectives of an R&D funding programme must not be restricted to short-term results : *"[...] the benefits of pre-competitive R&D are long-term rather than short-term, systemic rather than discrete, and accessible only through analysis of processes rather than by counting outputs or calculating return on investment."*[74]

While certain significant benefits of Switzerland's participation in FPs are not measurable, there is no doubt that FPs have various impacts in social (welfare, security, equality, education, ...), economic (employment, productivity, competitiveness, ...), environmental (energy, pollution, natural disasters, ...) or scientific areas (development of knowledge, young scientists, science policy, ...), even if it is not known to what extent or in what way, precisely.

Finally, Parliament's mandate implicitly requires this analysis of effects to focus on the advantages for Switzerland of participation in FPs. It is important to point out that the main concern of the FPs is to support the establishment of a European Research Area, and that the main positive effects of FPs are benefits for Europe as a whole, not necessarily for all the member states and associated countries considered individually.

Selection of indicators

The choice of indicators for evaluating the effects of FPs is, of course, subjective. It needs to be borne in mind that this active process of selecting, gathering and publishing data yields a partial view of the multifaceted phenomenon being studied. In particular, certain effects can only be partly captured or may even be distorted by the process of measurement based on a single indicator. Equally, an important effect may be completely overlooked if it is not revealed by any of the indicators selected. Consequently, the picture painted of Switzerland's participation depends on the indicators chosen. However, certain criteria may be formulated, which are both pragmatic and promote greater objectivity:

- The information provided by the indicators should meet Parliament's expectations (but also those of other stakeholders) of a study of this kind (Parliament's mandate, basis for the preparation of the next Dispatch on the financing of Switzerland's participation in the successor to FP7, synergies with other projects undertaken by the federal administration or affiliated institutions);
- The indicators should be measurable from a technical viewpoint, but also represent measurable quantities from a methodological perspective;
- The indicators should seek to measure concrete effects;
- The indicators should be simple, comprehensible and provide minimal scope for subjective interpretation;
- The set of indicators should cover all the relevant types of effects;

[73] - SER, 2005, *op. cit.*
- Arnold E., Balázs K., 1998, Methods in the Evaluation of Publicly Funded Basic Research. A Review for OECD, Technopolis
- Martin B. et al., 1996, The Relationship Between Publicly Funded Basic Research and Economic Performance, report to HM Treasury, Brighton: Science Policy Research Unit
- Arnold E., Thuriaux B., 1998, Forbairt Basic Research Grants Scheme: An Evaluation, Dublin: Forfás

[74] Quintas P., Guy K., 1995, Collaborative, pre-competitive R&D and the firm, Research Policy, Vol. 24, 325 – 348.

- As far as possible, the indicators should permit comparison with similar measurements (e.g. in other countries or for other institutions) so as to place them in a broader context, thereby facilitating interpretation.

Based on a study of the literature, a list can be drawn up of more than 90 indicators used to evaluate the impacts of public R&D funding programmes. The list presented in this report is the result of applying selected criteria with the aim of reducing the total number of indicators.
The indicators are classified under the four thematic headings presented in Table 5 below, selected from 13 classifications reviewed in the literature. This classification[75] meets the objectives of the project for two reasons. Firstly, it provides relatively complete coverage of all the effects. Secondly, the categories are constructed using a statistical technique which allows the indicators to be grouped into sets of indicators that are correlated within a given category, but with each being independent of the other categories. ■

Table 5:
Classification of indicators

No.	Category	Description, examples
1	Effects on support for research	Cost and risk sharing, access to research infrastructure, access to funding, etc.
2	Effects on the economy and employment	Services, products, standards, patents, spin-offs, jobs, etc.
3	Effects on scientific collaboration networks	Access to/expansion of networks, access to complementary expertise, internationalisation of activities, etc.
4	Effects on the generation of knowledge and skills	Employee qualifications, publications, expansion of knowledge base, etc.

[75] Adapted from BMBWK (Joanneum Research, Technopolis, VTT), 2001, Evaluation of Austrian Participation in the 4th EU Framework Programme for Research, Technological Development and Demonstration.

Companies surveyed on the impact of FPs

SMEs

Company	Area of activity	Participation in FPs No. Field
1 GAMMA Remote Sensing Research and Consulting AG Worbstr. 225 CH-3073 Gümligen	Services and hardware development in the area of radar remote sensing and microwaves	**FP6** 2 Space 1 Environment **FP7** 1 Space
2 HTceramix 26 Avenue des Sports CH-1400 Yverdon-les-Bains	University spin-off active in the development of solid oxide fuel cells	**FP6** 4 Energy 1 Marie Curie grant (knowledge transfer) **FP7** –
3 NewBehavior AG Quellenstrasse 31 CH-8005 Zurich	Technology for automated measuring and shaping of animal behaviour	**FP6** 4 Life sciences **FP7** –
4 RAPP Trans AG Hochstrasse 100 CH-4018 Bâle	Transport planning, transportation models, economic studies and systems design	**FP6** 4 Transport **FP7** –

Large companies

Company	Area of activity	Participation in FPs No. Field
1 Alstom (Schweiz) AG Brown Boveri Strasse 7 CH-5401 Baden	Transport and energy infrastructure, environmental protection technologies	**FP6** 4 Aeronautics 2 Energy 1 Marie Curie grant (training and experience) **FP7** 1 Energy
2 Swiss Center for Electronics and Microtechnology CSEM SA Rue Jaquet-Droz 1 CH–2002 Neuchâtel	Centre for innovation in micro- and nanotechnology and IT	**FP6** 25 Information technology 12 Nanotechnology 2 Research infrastructure 1 Aeronautics 1 Energy 1 Transport 1 Research for SMEs 1 Marie Curie grant (training and experience) 1 Emerging technologies **FP7** 8 Information technology 1 Space 1 Research infrastructure 1 Research for SMEs
3 IBM Zurich Research CH-8803 Rüschlikon	R&D in the fields of electronic chips, nanotechnology, supercomputers, security and optimisation of business transformation	**FP6** 18 Information technology 2 Nanotechnology 1 Marie Curie grant (training and experience) **FP7** 9 Information technology 2 Marie Curie grant (young researchers)
4 Procter & Gamble Switzerland Sàrl 47, route de St-Georges CH-1213 Petit-Lancy	Production of consumer goods (toiletries and cosmetics)	**FP6** 3 Nanotechnology 1 Transport 1 Environment 1 Innovation 1 Marie Curie grant (young researchers) **FP7** 1 Research infrastructure 1 Marie Curie grant (industry-academia partnerships)

Annex C References

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