Exploratory study
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New International Science and Technology Policies: Key Issues and Questions in Switzerland

An exploratory study conducted on behalf of the Swiss Science Council SSC

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With a foreword by Prof. Dr. Peter Weingart, South African Research Chair in Science Communication hosted by CREST at Stellenbosch University and Professor emeritus of Sociology, Sociology of Science and Science Policy of Bielefeld University

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The Swiss Science Council

The Swiss Science Council SSC is the advisory body to the Federal Council for issues related to science, higher education, research and innovation policy. The goal of the SSC, in conformity with its role as an independent consultative body, is to promote the framework for the successful development of the Swiss higher education, research and innovation system. As an independent advisory body to the Federal Council, the SSC pursues the Swiss higher education, research and innovation landscape from a long-term perspective.

Der Schweizerische Wissenschaftsrat

Der Schweizerische Wissenschaftsrat SWR berät den Bund in allen Fragen der Wissenschafts-, Hochschul-, Forschungs- und Innovationspolitik. Ziel seiner Arbeit ist die kontinuierliche Optimierung der Rahmenbedingungen für die gedeihliche Entwicklung der Schweizer Bildungs-, Forschungs- und Innovationslandschaft. Als unabhängiges Beratungsorgan des Bundesrates nimmt der SWR eine Langzeitperspektive auf das gesamte BFI-System ein.

Le Conseil suisse de la science

Le Conseil suisse de la science CSS est l'organe consultatif du Conseil fédéral pour les questions relevant de la politique de la science, des hautes écoles, de la recherche et de l'innovation. Le but de son travail est l'amélioration constante des conditions-cadre de l'espace suisse de la formation, de la recherche et de l'innovation en vue de son développement optimal. En tant qu'organe consultatif indépendant, le CSS prend position dans une perspective à long terme sur le système suisse de formation, de recherche et d'innovation.

Il Consiglio svizzero della scienza

Il Consiglio svizzero della scienza CSS è l'organo consultivo del Consiglio federale per le questioni riguardanti la politica in materia di scienza, scuole universitarie, ricerca e innovazione. L'obiettivo del suo lavoro è migliorare le condizioni quadro per lo spazio svizzero della formazione, della ricerca e dell'innovazione affinché possa svilupparsi in modo armonioso. In qualità di organo consultivo indipendente del Consiglio federale il CSS guarda al sistema svizzero della formazione, della ricerca e dell'innovazione in una prospettiva globale e a lungo termine.

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Peter Weingart is also a member of the 'Berlin-Brandenburgische Akademie der Wissenschaften' and of the 'Nationale Akademie für Technikwissenschaften – acatech'.

The authors contracted by the Swiss Science Council to produce the present exploratory study bear full responsibility for its contents.

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Preface by the SSC

It is reassuring to note that Swiss universities currently hold one Top 10 slot in the Times Higher Education World University Rankings. However, dynamics within the globalised knowledge-based economy have intensified in recent years. Strong players such as Brazil, India, China, South Africa, Japan and South Korea have high levels of research expenditure at home and large volumes of published scientific papers abroad. The general increase in publications by international co-authors, the mobility of researchers, a shift towards the 'brain circulation' strategy and greater international cooperation with BRICS countries are all indications of a shift in equilibrium and a changing scientific landscape.

Ranking lists such as the one mentioned and other indicator-based monitoring systems have facilitated the comparability of national science and technology systems; at the same time, the internationalisation of science has given rise to perceptions that nations are competing with one another. Within this context, international science and technology policies serve as an important lever enabling countries to position themselves over the long-term. In Switzerland, too, scientific diplomacy has intensified in recent years; the Swiss official network abroad has been expanded; and the scope of international cooperation has been broadened beyond the traditional focus on European countries to include non-European emerging and developing countries.

Against this backdrop, the Swiss Science Council SSC commissioned Alexandra Hofmänner to conduct an exploratory study entitled 'New International Science and Technology (S&T) Policies: Key Issues and Questions in Switzerland'. This was done to 'take a look inside the engine room' to see how well Switzerland is positioned at the level of S&T policy. How exactly does Swiss S&T policy work in terms of legal bases, instruments and mechanisms, responsibilities, strategies, committees, research programmes and processes? Are existing instruments sufficient to respond to globalised dynamics and proactively contribute to shaping these dynamics as needed?

The preface by the sociologist of science Peter Weingart places the study in the context of the history of science and more precisely the history of the relationship between (foreign) policy and science policy. He argues that the uniqueness or special status of science and technology policy is a thing of the past, explaining that today S&T policy must respond both to the economic need for innovation and the expectations of the general public. In order to be able to strike the right balance between these two potentially conflicting objectives, the 'S&T machinery' must operate smoothly.

The SSC discussed the conclusions and results of the exploratory study and recommends that the study be read by all those working in the field of international cooperation in science and innovation. This includes the Federal Administration as well as funding agencies or universities. The study identifies a number of issues and questions that are worth discussing.

Vorwort des SWR

In den THE World University Rankings befindet sich im Moment beruhigenderweise eine Schweizer Hochschule in den weltweiten Top 10. Doch die Dynamik innerhalb einer globalisierten Wissenschaftsökonomie hat in den letzten Jahren zugenommen. Starke Akteure wie Brasilien, Indien, China, Südafrika, Japan oder Südkorea tragen im eigenen Land hohe finanzielle Investitionen und im Ausland grosse Mengen von Veröffentlichungen bei. Die Zunahme von Publikationen von internationalen Mitautoren ganz allgemein, die Mobilität von Forschenden, eine Hinwendung zur Strategie der ‹brain circulation› oder die verstärkte internationale Zusammenarbeit mit den BRICS Ländern sind Hinweise dafür, dass sich Gleichgewichte verschoben haben und die Wissenschaftslandschaft in Veränderung begriffen ist.

Rankings wie das oben erwähnte oder andere Indikatoren-basierte Monitoring Systeme haben zur Vergleichbarkeit von nationalen Wissenschafts- und Technologie-Systemen beigetragen; aber auch dazu, dass die Internationalisierung der Wissenschaft als ein Wettbewerb der Nationen wahrgenommen wird. Sogenannte ‹internationale S&T-policies›, internationale Wissenschafts- und Technologiepolitiken (W&T-Politiken) sind in diesem Zusammenhang wichtige Hebel, um die Positionierung eines Landes nachhaltig zu sichern. Auch in der Schweiz wurden die Wissenschaftsdiplomatie in den letzten Jahren intensiviert, das Schweizer Aussennetz aufgestockt oder die internationale Zusammenarbeit neben dem traditionellen Fokus auf Europa auch auf Schwellen- und Entwicklungsländer ausgeweitet.

Auf diesem bewegten Hintergrund hat der Schweizerische Wissenschaftsrat SWR die vorliegende explorative Studie mit dem Titel ‹New International Science and Technology (S&T) Policies: Key Issues and Questions in Switzerland› bei Alexandra Hofmänner in Auftrag gegeben. Dies um gleichsam einen ‹Blick in den Maschinenraum› zu werfen und zu verstehen, wie gut die Schweiz auf der Ebene der W&T-Politik aufgestellt ist. Wie genau, mit welchen Gesetzesgrundlagen, mit welchen Instrumenten und Mechanismen, welchen Verantwortlichkeiten, Strategien, Komitees, Forschungsprogrammen oder Prozessen funktioniert die Schweizer W&T-Politik? Reichen ihre Instrumente aus, um auf eine globalisierte Dynamik reagieren und diese nach ihren Massstäben proaktiv mitgestalten zu können?

Das Vorwort des Wissenschaftssoziologen Peter Weingart bettet die Studie in den Kontext der Wissenschaftsgeschichte und genauer in die Geschichte der Beziehung von (Aussen-)Politik und Wissenschaftspolitik ein. Seine Tour d'Horizon führt uns vor Augen, dass die Einzigartigkeit oder der Sonderstatus der Wissenschafts- und Technologie-Politik der Vergangenheit angehören und dass sie heute sowohl auf das ökonomische Bedürfnis nach Innovation wie auf die Erwartungen der Öffentlichkeit eingehen muss. Um auf dieses Spannungsfeld reagieren zu können, muss die ‹W&T-Maschinerie› gut funktionieren.

Der Wissenschaftsrat hat die Schlussfolgerungen und die Resultate der explorativen Studie im Rat diskutiert und empfiehlt die Lektüre all jenen, die im Bereich der internationalen Zusammenarbeit im Dienste von Wissenschaft und Innovation tätig sind; dies sowohl in der Verwaltung wie bei Forschungsförderern oder Hochschulen. Aus der Untersuchung gehen eine Reihe von Problempunkten und Fragen hervor, die es sich zu diskutieren lohnt.

Préface du CSS

Selon les classements *Times Higher Education World University Rankings*, une haute école suisse figure actuellement parmi les 10 meilleures hautes écoles au monde. Ce résultat est rassurant face à la dynamique d'une économie du savoir désormais mondialisée qui s'est accélérée au cours des dernières années. Certains acteurs forts comme le Brésil, l'Inde, la Chine, l'Afrique du Sud, le Japon ou la Corée du Sud procèdent à d'importants investissements à l'intérieur de leurs frontières et se distinguent par un grand nombre de publications hors de leurs frontières. L'augmentation du nombre de copublications internationales de manière générale, la mobilité des chercheurs, l'orientation vers une stratégie de circulation des cerveaux ou le renforcement de la collaboration internationale avec les États BRICS sont autant de signes d'un bouleversement des équilibres et de changements dans le paysage scientifique.

Les classements tels que celui évoqué plus haut ou d'autres systèmes de monitorage fondés sur des indicateurs ont favorisé non seulement la comparabilité des systèmes scientifiques et technologiques nationaux, mais aussi la perception de l'internationalisation de la science comme une compétition entre les pays. Les politiques internationales dans le domaine des sciences et des technologies (S&T) constituent des leviers essentiels pour positionner durablement un pays. La Suisse, elle aussi, a mis l'accent sur la diplomatie scientifique au cours des dernières années, élargi son réseau extérieur ou étendu à des pays émergents et en voie de développement la coopération internationale qu'elle avait jusque-là centrée exclusivement sur ses partenaires européens.

Au vu de ce contexte mouvementé, le Conseil suisse de la science (CSS) a mandaté la présente étude exploratoire intitulée *New International Science and Technology (S&T) Policies: Key Issues and Questions in Switzerland* à Alexandra Hofmänner. L'objectif est double: examiner «la machinerie S&T» et déterminer où se situe la Suisse en matière de politique S&T. Comment fonctionne la politique S&T de la Suisse? Sur quels instruments, bases légales, mécanismes, responsabilités, stratégies, organes, programmes de recherche et processus repose-t-elle? Est-elle en mesure, avec les instruments dont elle dispose actuellement, de réagir à une dynamique mondialisée et de l'influencer directement selon ses propres critères?

La préface du sociologue de la connaissance scientifique Peter Weingart inscrit l'étude dans le contexte de l'histoire des sciences et, plus précisément, dans celui de l'histoire des relations entre la politique (étrangère) et la politique scientifique. Le tour d'horizon qu'il propose nous montre que la particularité ou le statut à part de la politique S&T appartient au passé et qu'elle doit désormais tenir compte à la fois du besoin d'innovation des entreprises et des attentes du grand public. Et pour réussir à concilier ces deux aspects, il faut une «*la machinerie S&T*» bien huilée.

Le Conseil suisse de la science a débattu des conclusions et des résultats de l'étude exploratoire. Il en recommande la lecture à tous ceux qui travaillent au service de la science et de l'innovation dans le domaine de la collaboration internationale, que ce soit dans l'administration, dans le cadre de l'encouragement de la recherche ou au sein des hautes écoles. L'analyse qui a été menée met en évidence un ensemble de problématiques et de questions qui méritent une discussion.

Prefazione del CSS

In questo momento nella top 10 dei *THE World University Rankings* si trova una scuola universitaria svizzera. Questo dato è certamente molto rassicurante, ma negli ultimi anni l'economia della conoscenza è diventata sempre più dinamica e protagonisti come il Brasile, l'India, la Cina, il Sudafrica, il Giappone o la Corea del Sud investono molto nei propri territori e sono responsabili di una grande quantità di pubblicazioni all'estero. L'aumento delle pubblicazioni scritte a più mani da autori di diversi Paesi e, più in generale, la mobilità dei ricercatori, il ricorso alla strategia della o la rafforzata cooperazione internazionale con i BRICS sono tutti segnali del fatto che gli equilibri si sono spostati e che il panorama scientifico sta cambiando.

Le classifiche e altri sistemi di monitoraggio basati su indicatori permettono di comparare l'avanzamento tecnologico e i sistemi economici nazionali, ma hanno anche portato a percepire l'internazionalizzazione della scienza come una competizione tra Paesi. Le politiche internazionali in materia di scienza e tecnologia sono pertanto un utile strumento per assicurarsi una posizione stabile. Negli ultimi anni anche la Svizzera ha potenziato la diplomazia scientifica, ampliato la propria rete esterna o esteso la cooperazione internazionale, affiancando all'attenzione particolare tradizionalmente destinata all'Europa anche uno sguardo ai Paesi emergenti e in via di sviluppo.

Alla luce di questo panorama movimentato, il Consiglio svizzero della scienza ha commissionato il presente studio esplorativo dal titolo «New International Science and Technology (S&T) Policies: Key Issues and Questions in Switzerland» di Alexandra Hofmänner. Lo scopo è, per così dire, dare un'occhiata sotto al cofano per capire qual è il livello delle politiche in materia di scienza e tecnologia della Svizzera. Come funziona veramente la politica svizzera in materia, quali sono le responsabilità, quali basi giuridiche, strumenti, strategie, comitati, programmi di ricerca o procedure ha a disposizione? Questi strumenti sono sufficienti per affrontare una realtà globalizzata e contribuire a plasmarla secondo le proprie regole?

La prefazione di professor Peter Weingart, sociologo della scienza contestualizza lo studio nella storia della scienza, più precisamente nella storia del rapporto tra politica (anche estera) e politica in materia di scienza. La panoramica tracciata ci mostra che le politiche in materia di scienza e tecnologia non sono più qualcosa di eccezionale o particolare, che l'innovazione al giorno d'oggi è una necessità e che bisogna andare incontro alle aspettative della popolazione. Per poter affrontare queste sfide, l'apparato scientifico e tecnologico deve essere ben funzionante.

Il Consiglio svizzero della scienza ha discusso i risultati e le conclusioni dello studio esplorativo e ne consiglia la lettura a tutti coloro che lavorano nel campo della cooperazione internazionale per il progresso scientifico e l'innovazione, che sia nell'amministrazione, presso enti promotori della ricerca o nelle scuole universitarie. Dalla ricerca emerge una serie di questioni e aspetti problematici che meritano una riflessione.

Foreword by
Prof. Dr. Peter Weingart

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The exceptionalism of science and technology policy is past

Science policy is a latecomer to the array of policy areas modern states have developed over the last century and a half. Only after the Second World War did governments begin to devise policies for the governance and public funding of research and higher education. If nowadays it is claimed that the 'exceptionalism' of science is over, this observation has the state of affairs in the 1950s as a reference. At that time science was perceived to be separate and insulated from society. The emerging science policy was mainly devoted to funding basic research – mostly reacting to suggestions and demands from the scientific community that were channelled through national funding agencies and research councils. Setting priorities was left to experts whose language was incomprehensible and whose arguments and judgments, inseparable from their own interests, were far removed from citizens' daily concerns.

Some fields, notably high energy physics, received special attention from policymakers because of the sheer volume of the expenditures required for its sophisticated instruments. This was also the first field, together with astronomy, that forced governments to enter into international agreements such as CERN. But large-scale projects like particle accelerators, radio or optical astronomy telescopes as well as space satellites were still few and far between.

The US political scientist Don K. Price defined the 'exceptionalism' of science to mean that science is the only institution that receives public funds without having to account for them. This unique 'social contract' resting on the public's trust in science (which has since changed fundamentally) was reflected in the technocratic character of science policy. A marginal political field to begin with, science policy was outside the ideological divisions of political parties, rarely, if ever, made it into the headlines of the mass media and did not trigger discussions in appropriation committees or parliaments. Instead, basic science served as 'the maiden of freedom', in the words of President Eisenhower, i.e. free research was supposed to symbolise the superiority of the West over the countries behind the Iron Curtain. It was a token in the Cold War, looming larger than the applied science laboratories which, of course, existed as well but were devoted to practical objectives such as public health, medical care, agriculture, energy etc.

This exceptionalist state of science and science policy was short-lived. The US led the way to the first large technology programmes in civilian nuclear technology, data processing and aerospace from the mid-1950s onwards. The then fashionable so-called 'linear model' of innovation which stipulated that all economic innovation rested on prior discoveries in basic research and, thus, legitimated even lavish research budgets, nevertheless pointed towards ultimate economic utility as the objective of science policy. Science policy became science and technology policy, and as such, began to have implications for and an impact on economic policy. In other words: with time the science-politics nexus grew closer and more intense. The report shows quite succinctly the different phases of this development, albeit with the focus on Switzerland's engagement with the research programmes of the EU. It also describes in convincing detail what was to become a major challenge: to cope with the emerging involvement of science and science (and technology) policy by providing appropriate legal frameworks, administrative bodies and policy-making mechanisms fit to deal with the complexity of the growing number of relations and overlaps between different policy fields.

Internationalisation and globalisation

Modern science has always been seen as being universal and, thus, by implication as international. While this is undoubtedly the case for the natural sciences, the social sciences and humanities are more impregnated by cultural traditions and national characteristics even though there are differences between these disciplines. Nonetheless, international journals and conferences, student exchanges as well as visiting faculty programmes all speak to the fact that the academic community is truly international both in spirit and in organisation. Even at the height of the Cold War the division of the world was bridged by a scientific organisation such as the International Council for Science (ICSU, until 1998 International Council of Scientific Unions). Given this potential of science as a common basis of understanding, it is no accident that a confluence of scientific and political objectives became apparent and eventually resulted in a somewhat ambivalent conjunction reflected in the conceptual triad of 'science in diplomacy', 'diplomacy for science' and 'science for diplomacy'. Science can provide advice to inform foreign policy objectives, the classic scientific advice to policy making; diplomacy for science serves to facilitate international cooperation, and science for diplomacy pertains to the support scientific cooperation can provide for international relations. Thus, the objectives of what 'science diplomacy' stands for are at least twofold: to advance knowledge and scientific capability, and to advance national political as well as economic interests. Over the course of the last decades, some observers note, the latter perspective has become the dominant meaning of the term.

Although the concept of science diplomacy is said to have been coined only in 2009 its practice dates back to the immediate post-war years when, for example, the UK sent its first science attaché to its embassy in Washington in 1946. Since then many countries have embarked on various activities that fall under the rubric. Here again, one can trace the institutional development (and associated practices) from the initial focus on the advancement of knowledge through international cooperation and exchange to the advancement of national economic interests. If, as at least one study has shown, some scientists are reluctant to represent national interests this may be due to an implicit paradox: the orientation to international cooperation and exchange for the advancement of science turns into science being used as a tool in the international competition for national innovation capacity. To some scientists this amounts to an infringement on the freedom of science.

The demarcation between science policy and economic policy objectives was never very sharp. But with globalisation taking hold of national economies worldwide, with the 'discovery' of knowledge as a crucial resource for innovation, promoting the internationalisation of science has become inseparable from promoting and defending national economic advantages in an increasingly intensive global competition. In this new 'global political economy of knowledge', old political paradigms lose their validity, as Hofmänner's report argues convincingly, and the respective science communities and policymakers are well advised to face the resulting challenges in a critical stocktaking.

The number of actors involved, the range of objectives pursued, the history of political decisions with their respective time-bound conditions and individuals' idiosyncrasies involved do not allow for a fully coherent policy design. Rather than striving for a 'one-fits-all' institutional arrangement, the inherent conflict between scientific and political objectives of science diplomacy suggests multidimensional approaches and solutions. More likely, a multitude of policies will have to be put forth and tested for effectiveness. The report's diagnosis that the bottom-up paradigm of Swiss research promotion (still reflecting the national science organisation) needs to be replaced by a combination of bottom-up and top-down procedures is a plausible response in that it suggests retaining the self-organising capacity of science while calling for a conscious and reflected agenda setting and implementation of science and technology policy in support of global economic policy in the national interest.

From 'brain drain' to 'brain circulation'

The pressure on governments to formulate coherent policies for science and technology has increased not only because of the globalised competition for innovation. As orientation to national boundaries and characteristics gives way to international cooperation, 'big' and 'mega science' consortia with their complex organisational structures involving many countries have unavoidably shifted political perspectives from the national to the global. The post-war constellation with the United States representing uncontested leadership and European science striving to follow – mostly through exchanges and fellowships for students and scholars to US universities – has been replaced by a much more diverse pattern. The EU Lisbon summit in 2000 announced the bold objective to make 'the EU the most competitive and dynamic knowledge-based economy in the world', thereby recognising that science was a major resource for the future development of Europe. Setting up the 'European Research Area' (ERA) required bringing together and coordinating science organisations, governmental and industrial bodies across national boundaries. The foundation of the European Research Council (ERC) to support high-quality basic research involved the scientific community across Europe to act as a political actor for the first time. This development has made EU member countries interesting addresses for scientific exchanges and co-operations. The EU is not the only actor that has emerged. The BRICS countries (Brazil, Russia, India, China, South Africa) are on the verge of becoming full-scale players in international S&T policy. One of them, China, is even challenging the US lead in scientific publications. If especially some smaller countries became victims of 'brain drain' in the earlier constellation, they now are able to develop strategies that enable them to participate in 'brain circulation'.

The realisation among innovation economists and policymakers that the loss of human capital presents a serious problem for national economies has paved the way for measures to retain well trained university graduates and scholars and/or to provide attractive conditions for training and employment in order to participate in the international circulation of the highly educated as well as to regain expatriates. Efforts were undertaken by many countries to increase their science budgets, to establish centres of excellence and institutes of advanced studies, to establish or enlarge programmes for academic exchanges (e.g. the European ERASMUS programme that not only serves the circulation of students among EU member countries but also contributes to European integration). Many universities have established international offices and campuses in other countries to attract foreign students and academic staff. All these diverse activities give some credence to the rhetoric of the 'knowledge society' which gained widespread circulation in the globalisation and science policy discourses around the turn of the new millennium.

Comparing, evaluating, accounting

Part and parcel of the internationalisation of science and technology and the policies that accompany it is to make it 'visible' and to subject it to measuring and comparison. Policy making without some data base to proceed from and without some form of evaluation of outcomes, intended and unintended, inevitably remains ineffective and at best symbolic. Initial efforts to come to an international agreement on the measurement of R&D go back to 1962 when an OECD Working Party of National Experts on Science and Technology Indicators (NESTI) first agreed on a common approach, thereafter named, after the meeting place in Italy, 'Frascati Volume'. The statistics published in the Frascati volumes (which have been revised seven times so far) represent data from nearly forty countries and organisations. They provide the basis for international comparisons of R&D budgets and a host of other indicators which inform innovation policies.

The next step in the development of quantitative measures of science came almost by accident. So-called bibliometric indicators were created from an analysis of publication and citation activities in scientific journals, originally designed to facilitate the search for the uptake of research results mimicking search processes. Citation counts soon became accepted as performance measures by both the scientific community and science administrations. Interpreted as an indicator of peer recognition of originality in research they provide, for the first time, a view into the internal operations of science. Science policy bodies have since applied them to compare disciplinary communities in different countries, university departments and entire countries. Quantitative indicators became the chief tool of country comparisons (e.g. first in the US Science Indicator volumes) as one element of S&T policies and notably international rankings. As evaluative tools quantitative performance measures also serve the management of universities and scientific organisations that promise to be more effective than was possible before. (It should not be overlooked, though, that steering by indicators entails risks. Depending on their theoretical quality and the availability of data they are based on directing by numbers can produce unintended side effects.) With the introduction of 'new public management' (NPM) the trust in the internal operations of academia that characterised its earlier exceptionalism has been replaced by controlling methods much like those in the private sector. So pervasive has this practice become that the social scientist Michael Powers has coined the term 'audit society' to characterise it.

The significance of this development must also be seen before the background of a broader societal change. In the wake of the first crude protests against nuclear energy in the 1970s followed by a series of campaigns against other new scientific and technological developments such as biotechnology, so-called 'gene food', stem-cell research and issues around climate change, science policymakers and scientists have responded with increasing prudence. Now, some four decades later, societies are (or are at least perceived to be) more critical and demanding with respect to science policy. Policymakers try to 'engage' the public with various programmes ranging from science communication to 'citizen science', all of which reflect the gap between an ever more complex and specialised world of science and technology and a general public rightfully demanding to be informed about the risks and benefits involved. If the EU launches a programme with the title 'Responsible Research and Innovation' (RRI) this is a clear indication that science policy today has to accommodate both the goal of economic innovativeness and the need to be responsive to the public's interests and expectations. In other words, at least in principle S&T policy has reached the state of 'normal' policy fields: It can be reflective and accountable to the public at the same time.

However, problems remain. Responsiveness to public debates can also imply unprotected exposure to their fads and foibles, to the strategies of party politics or the short-term attention-cycles of the media. Public administrations may lack the requisite reflective knowledge to implement fine-grained S&T policies. In this respect this policy field with its longer timescales remains more vulnerable than others. Some countries have set up and/or support analytical capacity to produce specialised knowledge of the internal operations of the research process, of the conditions favouring innovation and to develop and monitor evaluative instruments for the effective political direction of science in a diverse and intricate setting of actors, countries, and objectives to be pursued. The present report gives an impressively detailed and comprehensive account of the challenges this represents for Switzerland.

Executive summary

Executive summary

Science, technology and innovation are considered the backbones of contemporary societies all over the globe. New power dynamics are currently reconfiguring the global political economy of knowledge. An emerging 'multi-polar' system has been identified in which emerging economies are seen to challenge the leading role of Western Europe, North America and Japan.

One response to these shifting sites of scientific power and conditions for research has been an increase in international S&T cooperation and science diplomacy. In parallel, new international S&T policies have been formulated to direct and support these emerging initiatives.

Switzerland, too, has developed new initiatives in S&T cooperation and science diplomacy over the past decade. This exploratory study aims to describe and analyse the Swiss international S&T policies that have been developed in response to global transformations. Its objective is to identify the strategic issues and key questions at stake in their future development.

Switzerland's international S&T policies have developed in four phases. Their strategic orientation during the first three phases (1952 to 1973, Phase I; 1973 to 1990, Phase II; 1990 to 2004, Phase III) focused primarily on the geographic boundaries of Europe. The most recent phase (2004 to 2017, Phase IV) coincides with the years of Switzerland's full association with the FPs (Framework Programmes for Research) of the European Union, and its temporary downscaling to third-country status between 2014 and 2016. During this phase, the strategic orientation of international S&T policies was expanded to non-European countries, with a particular focus on emerging economies and selected developing countries.

The features and mechanisms of the new international S&T policies of this last phase comprise new instruments for international research cooperation and science diplomacy, a totally revised statutory framework, institutional changes, and the appearance of new S&T policy committees and new international S&T policy documents. The new instruments for international research cooperation and science diplomacy include bilateral research programmes, international agreements, the 'external network for education, research and innovation', exploratory missions, and the full association with the FPs of the European Union.

In a next step, the report considers the resulting picture of the new international S&T policies of Switzerland against the academic literature on S&T policy. Overall, Swiss international S&T policies since 2004 have continued to focus in the first instance on participation with the FPs of the EU. At the strategic level, these policies required no reorientation – despite the critical problems caused for Swiss researchers, policymakers and research administrators by the downscaling of this participation to third-country status between 2014 and 2016. Another new domain, however, required attention: the implementation of the federal directive of 2005 to expand Swiss S&T policy to emerging and developing countries. This directive translated the challenge of responding to global transformations in the world of knowledge into a mission for federal S&T policy and its wider institutional S&T landscape.

Swiss international S&T policies had to address a plethora of new challenges over the past decade. The report concludes that Switzerland has responded to the new international pressures of globalisation with international S&T policies that centralised federal decision-making responsibilities in this policy domain. At the same time, there are signs of the development of international S&T policies at various institutional levels of the Swiss S&T landscape, such as advisory committees or international strategies. These initiatives, however, have remained dispersed and uncoordinated and have received no formalised federal support. So, while the last phase has seen an increase in actors involved in international S&T policies, steps to build a vibrant national policy community and networks in this domain of public policy have not accompanied this growth.

An interdepartmental working group without stakeholder consultation formulated the International ERI Strategy of 2010, issued by the SERI on behalf of the Federal Council. Although the document is widely referenced as an overarching policy framework for international S&T, its particular disposition has hindered its effectiveness and ability to strengthen the national policy community. On the whole, the new federal S&T policies have not resulted in new institutional structures and procedures; instead, the new initiatives for scientific cooperation and science diplomacy were largely assimilated into existing structures and procedures. The comprehensive revision of the legal framework for S&T in 2012 endorsed this approach in legal terms.

Furthermore, no comprehensive information is available on federal expenditure for international S&T cooperation and science diplomacy. This gap holds back the development of policies that connect objectives, decisions and implementation strategies to current challenges. In addition, the international S&T policies of the past decade have shifted the traditional distribution of competences between the federal agencies responsible for 'S&T cooperation' and 'development cooperation'.

The results of the exploratory study indicate that the new international S&T policies in Switzerland reflect an outdated S&T policy paradigm that is at odds with current legal, institutional and procedural policy practices on international matters. Furthermore, policy development over the past few years has focused mainly on the decision-making and implementation stages whereas the agenda-setting, policy-formulation and policy-evaluation stages have rather been disregarded. Based on these results, the report proposes four strategic issues and related sets of key questions for consideration to the Swiss Confederation in the years to come:

- Expenditure: How much money is Switzerland currently spending on international cooperation in research & innovation and science diplomacy? In which categories of expenditure? Which processes and committees guide investment decisions?

- Policy design: Who is involved in the different stages of the policy cycle for international S&T policies? Which instruments are employed for the agenda-setting, policy-formulation, decision-making, policy-implementation and policy-evaluation stages? What policy processes and committees are required in the future to secure quick and strategic responses to an environment of shifting challenges and opportunities?

- Complexity: Which new policy measures, procedures and instruments are required to sustainably address the increasing complexity of international S&T cooperation and science diplomacy? What new procedures and agencies can the federal government institute to fulfil its statutory responsibility to coordinate national and international S&T policies?

- Support for policy: What resources are needed to support policy? How can the production of and public access to these resources be promoted?

Executive Summary

Wissenschaft, Technologie und Innovation gelten weltweit als Rückgrat moderner Gesellschaften. Neue Machtverhältnisse führen derzeit zu einer Umgestaltung der globalen politischen Wissensökonomie. Es entsteht ein multipolares System, in dem aufstrebende Volkswirtschaften die führende Stellung von Westeuropa, Nordamerika und Japan infrage stellen.

Eine Reaktion auf diese Veränderung der wissenschaftlichen Kräfteverhältnisse und der Forschungsbedingungen ist der Ausbau der internationalen W&T (Wissenschafts- und Technologie)-Zusammenarbeit und der Wissenschaftsdiplomatie. Parallel dazu wurden neue internationale W&T-Politiken formuliert, um diese aufkommenden Initiativen zu unterstützen.

Auch die Schweiz hat im letzten Jahrzehnt im Bereich der W&T-Zusammenarbeit und der Wissenschaftsdiplomatie neue Initiativen entwickelt. Diese explorative Studie beschreibt und analysiert die internationalen W&T-Politiken der Schweiz, die als Antwort auf den globalen Wandel ausgearbeitet wurden. Ihr Ziel ist es, die strategischen Themen und die zentralen Fragen im Hinblick auf die künftige Entwicklung aufzuzeigen.

Die internationalen W&T-Politiken der Schweiz haben sich in vier Phasen entwickelt. Die strategische Ausrichtung in den ersten drei Phasen (Phase I: 1952 bis 1973, Phase II: 1973 bis 1990, Phase III: 1990 bis 2004) hielt sich im Wesentlichen an die geografischen Grenzen Europas. Die letzte Phase (Phase IV: 2004 bis 2017) fällt mit den Jahren der Vollassoziierung der Schweiz an die EU-Forschungsrahmenprogramme und der vorübergehenden Zurückstufung auf den Drittland-Status zwischen 2014 und 2016 zusammen. In dieser Phase wurde der strategische Fokus der internationalen W&T-Politiken auf nichteuropäische Länder ausgeweitet, mit einem besonderen Schwerpunkt auf aufstrebenden Volkswirtschaften und ausgewählten Entwicklungsländern.

Zu den Elementen und Mechanismen der neuen internationalen W&T-Politiken dieser letzten Phase gehören neue Instrumente für die internationale Forschungszusammenarbeit und Wissenschaftsdiplomatie, vollständig revidierte rechtliche Grundlagen, institutionelle Anpassungen und die Schaffung neuer Gremien und Dokumente zur internationalen W&T-Politik. Die neuen Instru-mente der internationalen Forschungszusammenarbeit und Wissenschaftsdiplomatie umfassen bilaterale Forschungsprogramme, internationale Abkommen, das sogenannte Aussennetz für Bildung, Forschung und Innovation, Sondierungsmissionen und die Vollassoziierung an die FP der EU.

In einem nächsten Schritt vergleicht der Bericht das aus den internationalen W&T-Politiken der Schweiz resultierende Gesamtbild mit der akademischen Literatur zur W&T-Politik. Allgemein konzentrierte sich die internationale W&T-Politik der Schweiz ab 2004 in erster Linie weiterhin auf die Beteiligung an den FP der EU. Auf strategischer Ebene war keine politische Neuausrichtung notwendig – trotz der schwerwiegenden Probleme für Schweizer Forschende, politische Entscheidungsträger und die Forschungsverwaltung aufgrund der Beschränkung dieser Beteiligung durch den Drittland-Status zwischen 2014 und 2016. Ein neuer Bereich erforderte jedoch zusätzliche Aufmerksamkeit: die Umsetzung der Richtlinie des Bundes von 2005 zur Ausweitung der Schweizer W&T-Politik auf Entwicklungs- und aufstrebende Länder. Durch diese Richtlinie wurde die Reaktion auf die globalen Umwälzungen in der weltweiten Wissensgemeinschaft zu einer Aufgabe der W&T-Politik und der gesamten institutionellen W&T-Landschaft.

Die internationale W&T-Politik der Schweiz musste in den vergangenen zehn Jahren unzähligen Herausforderungen gerecht werden. Der Bericht kommt zum Schluss, dass die Schweiz dem neuen Globalisierungsdruck mit einer internationalen W&T-Politik begegnete, die die Entscheidungskompetenzen in diesem politischen Bereich beim Bund zentralisiert. Gleichzeitig zeichnet sich auf verschiedenen institutionellen Ebenen der schweizerischen W&T-Landschaft die Entstehung neuer internationaler W&T-Politiken ab, beispielsweise in Form von beratenden Ausschüssen oder internationalen Strategien. Diese Initiativen bleiben jedoch zerstreut und unkoordiniert und erhalten bisher keine formelle Unterstützung durch den Bund. So hat die Anzahl der an der internationalen W&T-Politik beteiligten Akteure im vergangenen Jahrzehnt zwar zugenommen, dieses Wachstum ging aber nicht mit entsprechenden Schritten zum Aufbau einer dynamischen nationalen Gemeinschaft und Netzwerken in diesem Bereich der öffentlichen Politik einher.

Eine departementsübergreifende Arbeitsgruppe formulierte 2010 ohne Konsultation der Interessengruppen unter der Leitung des SBFI und im Auftrag des Bundesrates die internationale BFI-Strategie. Auch wenn das Dokument weithin als übergeordneter politischer Rahmen für die internationale W&T-Politik gilt, ist es aufgrund seiner Entstehung nicht genügend wirksam und kann die nationale Gemeinschaft nicht ausreichend stärken. Insgesamt haben die neuen W&T-Politiken des Bundes nicht zu neuen institutionellen Strukturen und Verfahren geführt; stattdessen wurden die neuen Initiativen zur Wissenschaftszusammenarbeit und -diplomatie weitgehend in bestehende Strukturen und Verfahren integriert. Die umfassende Revision des Rechtsrahmens für W&T von 2012 festigte diesen Ansatz auf rechtlicher Ebene.

Im Übrigen liegen keine vollständigen Informationen zu den Bundesausgaben für die internationale W&T-Zusammenarbeit und die Wissenschaftsdiplomatie vor. Diese Lücke erschwert die Entwicklung von Politiken, die Verbindungen zwischen den Zielen, Entscheidungen und Umsetzungsstrategien und den aktuellen Herausforderungen schaffen. Zu beobachten ist auch, dass die internationalen W&T-Politiken in den vergangenen zehn Jahren die traditionelle Verteilung der Kompetenzen zwischen den für die internationale Zusammenarbeit und die Entwicklungszusammenarbeit zuständigen Bundesbehörden verschoben haben.

Die Ergebnisse dieser explorativen Studie zeigen, dass die neuen internationalen W&T-Politiken in der Schweiz auf einem veralteten Paradigma beruhen, das nicht den aktuellen rechtlichen, institutionellen und verfahrenspolitischen Praktiken in internationalen Angelegenheiten entspricht. Darüber hinaus war die Politikentwicklung in den letzten Jahren hauptsächlich auf die Entscheidungsfindungs- und die Umsetzungsphase ausgerichtet, während das Agenda Setting sowie die Politikformulierung und -evaluation eher vernachlässigt wurden. Gestützt auf diese Ergebnisse schlägt der Bericht vier strategische Themen und damit zusammenhängende Schlüsselfragen vor, mit denen sich der Bund in den kommenden Jahren befassen sollte:

- Ausgaben: Wie viel gibt die Schweiz derzeit für die internationale Forschungs- und Innovationszusammenarbeit und die Wissenschaftsdiplomatie aus? In welchen Ausgabenkategorien? Welche Verfahren und Gremien leiten die Investitionsentscheide?

- Politikgestaltung: Wer ist an den verschiedenen Phasen des Politikzyklus für die internationalen W&T-Politiken beteiligt? Welche Instrumente werden für das Agenda Setting, die Politikformulierung, die Entscheidungsfindung, die Politikumsetzung und -evaluation eingesetzt? Welche politischen Verfahren und Gremien braucht es in Zukunft, um rasch und strategisch auf eine Umgebung mit sich verändernden Herausforderungen und Möglichkeiten reagieren zu können?

- Komplexität: Welche neuen politischen Massnahmen, Verfahren und Instrumente sind nötig, um der steigenden Komplexität der internationalen W&T-Zusammenarbeit und Wissenschaftsdiplomatie längerfristig gerecht zu werden? Welche neuen Verfahren und Strukturen könnte der Bund einsetzen, um seine gesetzlich vorgegebene Verantwortung für die nationale und internationale Koordination der W&T-Politiken wahrzunehmen?

- Politikunterstützung: Welche Ressourcen braucht es, um die Politik zu unterstützen? Wie können die Bereitstellung dieser Ressourcen und der öffentliche Zugang dazu gefördert werden?

Résumé

Dans le monde entier, la science, la technologie et l'innovation sont considérées comme les piliers des sociétés contemporaines. L'économie politique du savoir est actuellement reconfigurée par de nouvelles dynamiques du pouvoir, dont découle un système multipolaire dans lequel des économies émergentes remettent en question le rôle de chef de file de l'Europe occidentale, de l'Amérique du Nord et du Japon.

L'une des réponses à ces glissements dans la constellation des pôles scientifiques et dans les conditions de la recherche a été le renforcement de la diplomatie scientifique et de la coopération internationale dans le domaine des sciences et des technologies (S&T). Parallèlement, de nouvelles politiques S&T internationales ont été définies afin d'orienter et de soutenir ces approches émergentes.

Au cours de la dernière décennie, la Suisse a également mis l'accent sur de nouvelles mesures en matière de coopération S&T et de diplomatie scientifique. La présente étude exploratoire vise à décrire et à analyser les politiques S&T appliquées par la Suisse à l'échelle internationale en réaction aux transformations mondiales. L'objectif est d'identifier les thèmes stratégiques et les questions clés qui conditionnent la poursuite de ces politiques.

Le développement par la Suisse de politiques S&T internationales a connu quatre phases. L'orientation stratégique des trois premières phases (phase 1: 1952 à 1973, phase II: 1973 à 1990, phase III: 1990 à 2004) était principalement centrée sur les frontières géographiques de l'Europe. La phase IV (2004 à 2017) a coïncidé avec les années de pleine association de la Suisse aux programmes-cadres de recherche (PCR) de l'Union européenne (UE) et à sa rétrogradation temporaire au statut de pays tiers entre 2014 et 2016. Durant cette quatrième phase, l'orientation stratégique des politiques S&T internationales a été étendue au-delà des frontières de l'Europe et s'est plus spécialement concentrée sur les économies émergentes et sur un nombre défini de pays en voie de développement.

Les nouvelles politiques S&T internationales de cette dernière phase se caractérisent par de nouveaux instruments pour la coopération internationale en matière de recherche et la diplomatie scientifique, un cadre juridique complètement remanié, des changements sur le plan institutionnel ainsi que la création de nouveaux organes stratégiques et documents d'orientation internationaux dans le domaine S&T. Les nouveaux instruments au service de la coopération internationale en matière de recherche et de la diplomatie scientifique comprennent des programmes de recherche bilatéraux, des accords international, le réseau extérieur pour l'éducation, la recherche et l'innovation, des missions exploratoires et la pleine association de la Suisse aux programmes-cadres de recherche de l'UE.

Dans un deuxième temps, le rapport met en parallèle la vue d'ensemble des nouvelles politiques S&T internationales de la Suisse avec les publications sur ce type de politique. Depuis 2004, le fil conducteur des politiques S&T internationales de la Suisse reste la participation aux programmes-cadres de recherche de l'UE. Sur le plan stratégique, l'orientation de ces politiques n'a pas dû être revue, et ce, malgré les difficultés que la rétrogradation au statut de pays tiers entre 2014 et 2016 a occasionnées en Suisse pour les chercheurs, les décideurs et les gestionnaires de la recherche. Il en a été tout autre pour l'application de la décision du Conseil fédéral de 2005 visant à étendre la politique S&T de la Suisse à un nombre défini de pays émergents et en voie de développement. Cette décision a permis de faire du défi que représente la réponse à apporter aux transformations de la société mondiale du savoir une mission relevant de la politique fédérale dans le domaine S&T et du paysage institutionnel correspondant.

Au cours de la décennie passée, les politiques S&T internationales de la Suisse ont eu toute une série de nouveaux défis à affronter. Le rapport conclut que la Suisse a répondu aux nouvelles pressions internationales en termes de mondialisation en adoptant des politiques S&T internationales qui centralisent les responsabilités fédérales en matière de prise de décisions dans ce domaine. Dans le même temps, on constate le développement de politiques S&T internationales à différents niveaux institutionnels du paysage S&T suisse, par exemple au travers d'organes consultatifs ou de stratégies internationales. Il s'agit toutefois de mesures dispersées qui souffrent d'un manque de coordination et d'un soutien fédéral officiel. Par conséquent, si une augmentation du nombre d'acteurs participant aux politiques S&T internationales a marqué la phase la plus récente, elle n'a pas été pour autant associée à une dynamique visant à rassembler ces acteurs, à l'échelle nationale, en vue de créer une communauté et des réseaux dans ce secteur de politique publique.

La définition par un groupe de travail interdépartemental de la Stratégie internationale de la Suisse dans le domaine FRI de 2010, qui a été publiée par le SEFRI sur mandat du Conseil fédéral, n'a pas inclus une procédure de consultation auprès des acteurs concernés. Même si le document est considéré comme un cadre stratégique global pour les activités S&T à l'échelle internationale, cet aspect particulier du processus d'élaboration a compromis son efficacité et sa capacité à mobiliser la communauté nationale autour de cette stratégie. Dans l'ensemble, les nouvelles politiques S&T fédérales n'ont pas fait naître de nouvelles structures et procédures institutionnelles. Par contre, les nouvelles mesures prises dans le cadre de la diplomatie scientifique et de la coopération dans le domaine des sciences ont trouvé leur place dans les structures et procédures qui existaient déjà. La révision totale du cadre légal menée en 2012 pour les activités S&T a avalisé cette approche sur le plan juridique.

À cela vient s'ajouter le déficit d'information sur les dépenses fédérales dans le domaine de la coopération S&T internationale et de la diplomatie scientifique. Cette lacune freine le développement de politiques reliant les objectifs, les décisions et les stratégies de mise en œuvre aux défis actuels. De plus, les politiques internationales menées au cours de la dernière décennie dans le domaine S&T ont modifié la répartition habituelle des compétences entre les offices fédéraux responsables de la coopération S&T et du développement de la coopération.

Les résultats de l'étude exploratoire indiquent que les nouvelles politiques internationales de la Suisse en matière de S&T reposent sur une conception dépassée qui n'est pas en adéquation avec les pratiques légales, institutionnelles et procédurales en vigueur pour traiter les questions internationales. Le développement des politiques au cours des dernières années a eu en outre tendance à se focaliser sur la prise de décisions et la mise en œuvre, et à négliger d'autres étapes telles que la définition des priorités ou la conception et l'évaluation des politiques. Compte tenu de ces résultats, le présent rapport propose quatre axes stratégiques avec, pour chacun, un ensemble de questions clés que la Confédération devra prendre en compte au cours des prochaines années:

- Dépenses: quel est le montant que la Suisse consacre actuellement à la coopération internationale en matière de recherche et d'innovation ainsi qu'à la diplomatie scientifique? Pour quels types de dépenses? Quels processus et organes influent sur les décisions en matière d'investissements?

- Conception des politiques: qui participe aux différentes étapes du processus d'élaboration des politiques S&T internationales? Quels instruments sont utilisés pour définir les priorités, élaborer les politiques, prendre les décisions, mettre en œuvre et évaluer les politiques? Quels processus et organes doivent être créés afin de garantir des réponses rapides et stratégiques dans un contexte de possibilités et de défis toujours en mouvement?

- Complexité: quels instruments, mesures et procédures stratégiques doivent être envisagés pour répondre de manière durable à la complexité croissante de la coopération S&T internationale et de la diplomatie scientifique? Quels organes et procédures l'administration fédérale doit-elle instituer afin d'assumer la responsabilité qui lui incombe dans la coordination des politiques S&T à l'échelle nationale et internationale?

- Soutien des politiques: quelles ressources sont nécessaires pour soutenir les politiques? Comment promouvoir la mise en place d'un accès public à ces ressources?

Riassunto

L'avanzamento scientifico, la tecnologia e l'innovazione sono considerati la spina dorsale delle società moderne di tutto il mondo. Nuove dinamiche di potere stanno cambiando l'economia mondiale della conoscenza. Si assiste all'affiorare di un sistema pluricentrico in cui le economie dei Paesi emergenti sfidano l'egemonia dell'Europa occidentale, dell'America del Nord e del Giappone.

Una reazione allo spostamento del potere scientifico e dei centri di ricerca è stata l'intensificazione della cooperazione internazionale per il progresso scientifico-tecnologico e della diplomazia scientifica. Parallelamente sono state elaborate politiche per guidare e sostenere le nuove iniziative.

Negli ultimi dieci anni anche la Svizzera ha sviluppato nuove iniziative in questi ambiti. Questo studio esplorativo vuole descrivere e analizzare le politiche internazionali in materia di scienza e tecnologia sviluppate dalla Svizzera in risposta ai cambiamenti globali. L'obiettivo è identificare gli aspetti strategici e le questioni da affrontare nei futuri sviluppi.

Le politiche internazionali della Svizzera in materia di scienza e tecnologia si sono sviluppate in quattro fasi. L'orientamento strategico delle prime tre fasi (1952–1973 prima fase, 1973–1990 seconda fase, 1990–2004 terza fase) si è concentrato soprattutto sul continente europeo. La quarta fase (2004–2017) coincide invece con gli anni della piena adesione della Svizzera ai programmi quadro di ricerca (PQ) dell'Unione europea e del successivo declassamento a Paese terzo tra il 2014 e il 2016. In quest'ultimo periodo l'orientamento strategico delle politiche svizzere ha guardato al di là dei Paesi europei, con particolare attenzione alle economie emergenti e a determinati Paesi in via di sviluppo.

Le caratteristiche e i meccanismi delle politiche internazionali in ambito scientifico-tecnologico di quest'ultima fase includono nuovi strumenti per la cooperazione internazionale nel campo della ricerca e per la diplomazia scientifica, un quadro giuridico completamente riveduto, cambiamenti a livello istituzionale, la comparsa di nuovi comitati per le politiche di scienza e tecnologia nonché di nuovi documenti di politica internazionale in materia. Tra i nuovi strumenti per la cooperazione internazionale nel campo della ricerca e per la diplomazia scientifica si annoverano programmi di ricerca bilaterali, accordi internazionali, la rete esterna per la formazione, la ricerca e l'innovazione, missioni esplorative e la piena adesione ai PQ dell'Unione europea.

In una fase successiva lo studio considera il quadro risultante dalle nuove politiche internazionali della Svizzera alla luce della letteratura accademica sulle politiche in materia di sviluppo scientifico e tecnologico. In generale, dal 2004, le politiche internazionali svizzere si sono sempre concentrate in primo luogo sulla partecipazione ai PQR dell'Unione europea. Nonostante le grandi difficoltà affrontate dai ricercatori, dai decisori politici e dal personale amministrativo in seguito al declassamento della Svizzera a Paese terzo, sul piano strategico non è stato necessario riorientare queste politiche. Una nuova questione ha invece richiesto attenzione: l'applicazione della direttiva del 2005 in cui il Consiglio federale esprimeva l'intenzione di estendere la politica in materia di scienza e tecnologia ai Paesi in via di sviluppo. Questa direttiva trasformava la sfida dei cambiamenti nel mondo della conoscenza in una missione per le politiche federali e l'ampio panorama delle istituzioni scientifiche.

Negli ultimi dieci anni la politica internazionale svizzera in ambito scientifico e tecnologico ha affrontato una grande varietà di sfide. Lo studio giunge alla conclusione che la Svizzera abbia reagito alle nuove pressioni internazionali della globalizzazione accentrando a livello federale il processo decisionale per questioni legate alla scienza e alla tecnologia. Nel contempo, all'interno dei vari ambiti istituzionali del panorama scientifico e tecnologico della Svizzera, ci sono stati segnali di sviluppo delle politiche internazionali in materia, come la creazione di comitati consultivi o strategie internazionali. Prive di coordinamento e sostegno ufficiale a livello federale, queste iniziative sono però rimaste isolate. Nonostante nell'ultima fase ci sia stato un aumento dei soggetti coinvolti nelle politiche internazionali in materia di avanzamento scientifico e tecnologico, questo non è stato accompagnato da provvedimenti necessari a creare una rete e una comunità politica attiva in questo campo.

Un gruppo di lavoro interdipartimentale, senza consultazione delle parti interessate, ha formulato la strategia internazionale nel settore educazione, ricerca e innovazione (ERI) del 2010, pubblicata dalla SEFRI su incarico del Consiglio federale. Sebbene questo documento sia spesso considerato un quadro politico comprensivo, la sua particolare formulazione ne ha frenato l'efficacia e la capacità di rafforzare la comunità politica nazionale. Nel complesso le nuove politiche federali non hanno creato nuove strutture e procedure; al contrario, le nuove iniziative per la diplomazia e la cooperazione scientifica sono state assorbite da strutture e procedure già esistenti. Nel 2012 questo approccio è stato confermato nella revisione totale del quadro giuridico in ambito scientifico e tecnologico.

Inoltre non sono disponibili informazioni complete sulla spesa a livello federale per la cooperazione internazionale in tale ambito. Questa lacuna rallenta la creazione di politiche in grado di collegare obiettivi, decisioni e strategie di applicazione con le sfide in corso. In aggiunta, le politiche internazionali degli ultimi dieci anni hanno diluito la distribuzione delle competenze tra i diversi uffici federali responsabili della cooperazione in ambito scientifico e della cooperazione allo sviluppo.

I risultati dello studio indicano che le nuove politiche internazionali della Svizzera in ambito scientifico e tecnologico riflettono un paradigma politico datato che male si concilia con le attuali prassi legali, istituzionali e procedurali per le questioni internazionali. Negli ultimi anni, inoltre, lo sviluppo delle politiche si è soffermato maggiormente sul processo decisionale e sulle fasi di attuazione, mentre l'impostazione di un'agenda, la formulazione e la valutazione delle politiche sono state piuttosto trascurate. Sulla base di questi risultati, lo studio individua quattro problemi strategici e una serie di domande chiave correlate che la Confederazione Svizzera dovrà tenere in considerazione nei prossimi anni:

- Spesa: quanto denaro investe al momento la Svizzera nella diplomazia scientifica e nella cooperazione internazionale nel campo della ricerca e dell'innovazione? In quali categorie di spesa? Quali processi e quali associazioni concorrono nelle decisioni sugli investimenti?

- Elaborazione delle politiche: chi viene coinvolto nelle diverse fasi del processo decisionale? Quali sono gli strumenti impiegati nelle fasi di impostazione dell'agenda, formulazione delle politiche, decisione, attuazione e valutazione? Quali procedimenti e quali comitati saranno necessari in futuro per reagire strategicamente e con rapidità alle nuove sfide e opportunità?

- Complessità: quali nuovi provvedimenti, procedure e strumenti sono necessari per affrontare la crescente complessità della cooperazione internazionale in ambito scientifico-tecnologico e della diplomazia scientifica? Quali procedure e agenzie può creare il Consiglio federale per coordinare le politiche nazionali e internazionali in materia di scienza e tecnologia?

- Sostegno alle politiche: quali risorse sono necessarie per sostenere le politiche? Come promuovere l'accesso a queste risorse e la loro produzione?

Introduction

1

The international map of scientific excellence is undergoing a transformation. New global forces and players influence the international political economy of science and technology (S&T). The classical indicators for S&T for the past few years provide impressive numbers to describe some of these changes. While the world shares of publications of both the EU and the USA fell between 2010 and 2015, China's publications have nearly doubled (Soete et al., 2015:33). High-income economies still dominate the international map, but there are signs of the appearance of new players in emerging or transforming economies, such as Brazil, India, South Africa or South Korea. New information and communication technologies have changed research practices and have multiplied the possibilities for international research cooperation. Researchers have become more mobile. New forms of competition among nations have appeared, illustrated by a shift in concern from 'brain drain' to 'brain circulation'. The numbers of internationally co-authored scientific publications have increased. Science, technology and innovation are also increasingly viewed as critical sources to address complex problems of global scale. The achievement of the recently adopted UN Sustainable Development Goals is considered to be dependent on science, technology and innovation that cross both disciplinary and national boundaries.

General agreement appears to prevail in Western Europe and North America on the need for new national and international science & technology (S&T) policies to respond to these changing international conditions[1]. Governments have come under pressure to adjust or transform their customary S&T policy structures and processes to respond to international influences. But transnational organisations, too, such as the European Union, have started to develop new S&T policy structures and processes to strengthen their international position. In 2008, the European Union launched a series of strategic initiatives to put in place a range of policy instruments to expand the EU's international cooperation activities in science and innovation (Godin, 2009)[2].

The policy response to the new international S&T dynamics of Germany offers another example. Within only a few years, the German Federal Ministry of Education and Research has developed institutional structures, policy analyses and information platforms to strengthen its international S&T policies. Policy-formulation processes have been carried out to develop a series of strategy and policy documents that support the internationalisation of Germany's research landscape. These policy measures include policy guidelines or strategy documents for specific regions such as China or Africa, as well as action

1 E.g. European Commission, 2008 and 2012; OECD 2005, 2010a, 2010b, 2011 and 2012; the Royal Society, 2010; U.S. National Academy of Science (NAS), 2011; the Swiss Federal Council, 2010.

2 In 2008, the Scientific and Technical Research Committee of the European Community (CREST, Comité de la Recherche Scientifique et Technique) established a Strategic Forum for International S&T Co-operation; four years later the Forum was reconstituted as an advisory group to the successor of CREST, the European Research Area Committee (ERAC, established in 2010). ERAC advises the Council and the European Commission.

plans and joint strategies by federal and regional governments[3]. The first strategy of the German Federal Government of 2008 ('Internationalisation of Education, Science and Research') has recently been revised ('Internationalisation Strategy') and adopted by the Federal Cabinet in 2017.

In Switzerland an 'International Education, Research and Innovation Strategy' (IERIS) was drafted under the lead of the State Secretariat for Research (SER, today the SERI) and approved by the Federal Council in 2010.

Against this background of rapid change, the exploratory study investigates the following questions:

1. How have Swiss international S&T policies developed historically? (Chapter 2)

2. Which new features and mechanisms typify the current era and set it apart from previous international S&T policies? (Chapter 3)

3. What broad strategic issues and questions should be addressed to strategically enhance sustainable international S&T policies for the future? (Chapter 4)

A lot has been achieved over the past decade to address the rapidly transforming circumstances for international S&T policies. International S&T policies are of course exposed to short-term political developments in other fields of public policy. This interdependency is exemplified in the temporary downscaling of Switzerland to third-party status in the FPs of the EU between 2014 and 2016. Significant financial and human resources had to be invested at short notice to regain the country's status of fully associated country, due to an unexpected outcome of a public vote on immigration. The interdependency of public policy fields, however, requires an analytical perspective that goes beyond the field of international S&T policy.

The focus of this exploratory study lies on the strategic S&T policy challenges for Switzerland in an increasingly globalised political economy of knowledge. While the report presents no evaluation of Swiss international S&T policies; this focus commands a critical historical perspective.

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3 For example, *Afrikapolitische Leitlinien der Bundesregierung* (2014); *Aktionsplan Internationale Kooperation* (BMBF 2016), *Die Afrika-Strategie* (2014–2018) (BMBF 2017), *Die China-Strategie* (2015–2020) (BMBF 2015), the *Strategie der Wissenschaftsminister/innen von Bund und Ländern für die Internationalisierung der Hochschulen in Deutschland* (adopted in 2013).

Historical development of international S&T policies in Switzerland

2

Historical development of international S&T policies in Switzerland

This development of international S&T policies[4] in Switzerland is recounted along four strategic phases. For most of their history, international S&T policies in Switzerland have focused primarily on the countries of the European Union and its predecessors. The first three phases, therefore, are predominantly directed at participating in European S&T activities. Over those years, European S&T policy matured from coordinating selective joint projects and programmes to the joint governance structures of the European Research Area of the European Union. In parallel, though outside of S&T policy spotlight, Switzerland also developed international S&T policies that focused on developing countries running under the label development cooperation.

Switzerland's earliest international S&T policies after the Second World War aimed to secure participation in the first European efforts to cooperate in joint S&T projects, such as CERN, ESRO, or EMBC between 1952 and 1973. By the end of this phase, Switzerland had instituted its first S&T policy agencies in public administration and was a founding member of the COST Programme. Between 1973 and 1990, the focus of the second phase of international S&T policies of Switzerland was on participation in the emerging European research programmes such as EURATOM and EUREKA. These policy activities succeeded in settling, by the end of this phase, a Framework Agreement on Scientific and Technological Co-operation between the Swiss Confederation and the European Communities that is currently still in effect. This agreement paved the way for Swiss participation in the emerging Research Framework Programmes (FPs), which began in 1987, though with limited access to the funding programmes because of the status of Switzerland as a third-party country. Over the course of the following third phase, from 1990 to 2004, international S&T policies were developed to increase the scope of Swiss participation in the FPs. This phase ended with the full association of Switzerland to the FPs in 2004. Only one year later, the Swiss Federal Council decided to expand its foreign policies to non-European countries. Although it maintained its international S&T policy activities in Europe during this last phase – and these had to be intensified temporarily between 2014 and 2016 due to the temporary downgrading of Switzerland as third-party country in the FPs – the strategic challenges of the international S&T policies of Switzerland during this last phase since 2004 concerned the expansion of S&T cooperation and science diplomacy to non-European countries. An overview of these phases is presented in Table 1.

4 For the sake of clarity, international S&T policies is used as an overarching expression to designate a broad range of related labels that have been used over the past fifty years and for the purpose of this report includes the related terms research and development, and most recently innovation.

	Phase I 1952–1973	Phase II 1973–1990	Phase III 1990–2004	Phase IV 2005–?
Strategic focus	Participation in European research projects	Participation in European research programmes	Participation in the FPs of the EU (as third country)	Full association in the FPs of the EU Cooperation with emerging & developing countries
Milestones	1952 SNSF 1960 Service for Technical Assistance	1973 Research Article 1976 Federal Law on International Development Co-operation and Humanitarian Aid 1983 Research Act 1986 S&T Framework Agreement Switzerland / EC	1990 Science Councillor Brussels 1996 Swisscore Brussels 1999 ERI-Dispatch 2004 Full association FPs of the EU	2005 Federal Council decision to expand foreign policies to emerging & developing countries 2010 International ERI-Strategy 2012 RIPA 2013 HEdA, SERI
New S&T activities	CERN (1953) COST (1971)	IEA (1974), ESA (1975), EURATOM (1979), ESO (1981), ESP (1982), EUREKA (1985), Science Councillor Tokyo (1986)	First Swiss participation in FPs (1987), pilot programmes with China and India, Swissnex Boston (2000), Swissnex San Francisco (2003), Swissnex Singapore (2004)	Bilateral Research Programmes (2008–), international agreements, Swiss ERI-Network, exploratory S&T missions, r4d Programme (2012)

Table 1: Overview of strategic focus, milestones and new S&T activities of the four historical phases of international S&T policies of Switzerland

2.1
Participation in European research projects (1952–1973)

The earliest phase of international S&T policies in Switzerland began in the years following the Second World War and lasted up until the early 1970s. These policies grew hand in hand with the development of national S&T policies. Switzerland participated in the European S&T policy-development process leading up to two major European S&T cooperation projects that have endured to the present day: CERN and COST. These projects instigated the first international S&T policy instruments and organisational structures in federal administration to position Swiss S&T within the larger European political economy of science and technology of the day.

Before the Second World War, science, technology and research were generally not regarded as a public policy domain of the nation state. This view changed in the aftermath of war and reconstruction efforts. National institutions were established to assume state responsibilities for promoting S&T. Switzerland's first federal institution to assume a federal role in the distribution of funds for research, the Swiss National Science Foundation, was established in 1952[5]. The major scientific associations approached the federal council with a proposal to establish a private foundation with federal funds to promote research across the disciplines. International considerations formed part of their rationale; scientists were concerned that public expenditure for scientific research was increasing in many Western countries and that insufficient financial resources were available in Switzerland to keep up with this pace. Difficulties to raise funds for international scientific relations and travel, too, were named explicitly. These considerations supported their argument that the promotion of scientific research was a crucial responsibility of modern states, and that scientific cooperation with 'foreign countries' needed to be fostered because of its vital importance for the future of Swiss research. The Swiss National Science Foundation was established as an institution under private law mandated by the Swiss Federal Government.

During these same years, plans were developed at the UNESCO Secretariat to establish a European nuclear research centre. Eventually, these early ideas on an international enterprise were transformed into the regional European initiative CERN in 1952. This initiative aimed at securing an international position for Europe in the field of physics (Elzinga, 1996:181). Switzerland was among the eleven founding members of CERN. The Swiss site that had been selected for the European research centre in Geneva, Switzerland, required the project to pass both federal and cantonal political jurisdiction. After the Swiss Parliament had approved of a financial contribution of one million Swiss francs to CERN in 1952, the project was approved by a cantonal referendum in Geneva in 1953.

CERN set a precedent for Swiss participation in European research initiatives. A number of other projects followed in the area of space science (European Space Research Organisation ESRO in 1962), molecular biology (European Molecular Biology Organization EMBO in 1969), and Mediterranean science (CIESM in 1970). By the early 1970s, the Federal Council considered the number of proposals for participation in international scientific cooperation to have increased to the extent that financial constraints would require a selection. It called upon the OECD to undertake a systematic overview analysis of its cooperative projects and on the Swiss Science Council to deliver the necessary local data to inform this selection (Federal Dispatch, 1972:413).

In 1961, Swiss Parliament allocated a framework budget of 60 million Swiss francs to a programme of development aid for 'third world countries' and elevated the newly established 'Service for Technical Assistance' (1960) to the 'Service for Technical Cooperation' at the Federal Political Department. This step mirrored European developments in the early 1960s, which put into place international S&T policies under the label of technical assistance to developing countries[6]. The Development Assistance Committee (DAC) had just been formed in 1960 by the OEEC as a forum for consultations among aid donors on assistance to less-developed countries[7].

In 1963, the OECD held its first Ministerial Meeting on Science in Paris and published the so-called Piagnol report on *Science and the Policies of Governments*. The report proposed recommendations for member governments for establishing scientific advisory bodies to government to support national S&T. This document transformed a political ambition into a strategic policy doctrine. Science and Education was elevated to a productive factor for the pursuit of economic growth (Elzinga & Jamison, 1995:584). In the wake of these European developments, Switzerland established a number of science policy institutions: the Swiss Science Council (1965); the parliamentary Science, Education and Culture Committee (SECC) (1967); the Division for Science and Research at the Federal Department of Home Affairs (FDHA) (1969); the interdepartmental Coordinating Committee for Science and Research (1969) and the Swiss University Conference (SUC) (1969). In 1968, a Federal Act was passed on the Funding of Higher Education in Switzerland. It paved the way for subsequent funding applications to Parliament by way of Federal Dispatches on research. Federal funds for Swiss participation in European S&T projects, however, continued to be applied for in individual dispatches.

5 Exceptions were the Swiss Federal Institute of Technology in Zurich (ETHZ); research promotion in the area of atomic energy, small contributions by the foundation Pro Helvetia, and funds for basic research within the federal job-creation programme during the Second World War.

6 Examples are the International Development Association (IDA) of the World Bank (launched in 1960) or Canada's 'External Aid Office', later renamed the Canadian International Development Agency (CIDA) in 1968 (OECD, 2006). Switzerland joined the IDA in 1992.

7 The DAC was reconstituted as the Development Assistance Committee after the establishment of the OECD in 1961 (OECD, 2006:8).

Switzerland participated in the preparations leading up to the establishment of COST (Cooperation in Science and Technology) in 1971; the first intergovernmental S&T project of Western European countries under the European Community. The Division for Science and Research at the FDHA, established only two years earlier, assumed the administrative management of the Swiss COST actions. This parallel establishment of Swiss national S&T policy institutions, OECD programmes and European S&T projects, illustrates the early interdependence of national and international S&T policies in Switzerland (Gees, 2012).

In 1972, the Swiss Federal Council applied to Parliament to amend the Swiss constitution to endorse the promotion of education and research as a federal responsibility. Again, the arguments in support of anchoring these responsibilities at a federal level included international research cooperation (Federal Dispatch, 1972:412). The Research Article 27sexies was included in the Federal Constitution in 1973, after it had been accepted by popular vote by the Swiss people.

Swiss international S&T policies during this first phase aimed at securing participation as a neutral country in the emerging S&T initiatives of the European Community. They were also used as leverage to further the local need for federal S&T policy structures and organisations. Policy instruments included federal dispatches, decrees, and international treatises that required the approval of parliament (CERN, COST). But the establishment of national S&T institutions, committees and delegations, too, was a tool for developing international S&T policies for Switzerland. They were instituted without legal foundations and before federal competences were enshrined in the research article of the Swiss constitution. Cooperation projects with European countries during this phase were focused on technology (CERN, COST, ESRO). The S&T policy discourse was only just emerging in Europe. New categories and indicators were introduced to allow for comparison between countries. The distinction between basic and applied research and experimental development was later codified in the Frascati Manual. In this phase, the term 'International S&T cooperation' in practice designated S&T cooperation with Western Europe, and focused mainly on the technological research in nuclear and particle physics, space research, and molecular biology.

2.2 Participation in European research programmes (1973–1990)

The strategic focus of the second phase of international S&T policies (1973 to 1990) was on securing participation in European research programmes. Two major programmes stand out as successful and symbolical examples for these policies: the EURATOM and EUREKA programmes. Major legal, institutional and political developments shaped a national S&T policy landscape during these years. It took another decade after the authority of federal government for national S&T policy had been enshrined in the Swiss constitution, to enforce the first Research Act. Amongst others, it authorised the use of federal funds to take part in international scientific collaboration and conferred to the Federal Council the power to enter into international agreements on behalf of the Swiss Confederation. Prior to this legislation, all international projects and programmes had required approval by Parliament. Until 1990, financial allocations for participation in European projects and programmes were not included in the four Federal Dispatches on the Promotion of Scientific Research.

One of the milestones in the international S&T policies of Switzerland during this phase was the signing of a framework agreement with the European Communities in 1986[8]. This framework agreement offered the necessary point of entry for Swiss participation in the new FPs and would continue to provide the basis for further negotiations over the next thirty years. Towards the end of this phase, Switzerland was allowed to participate in the new FPs on a project basis and the EPFL submitted the first Swiss FP proposal in 1988. The first FP had been launched in 1984 to promote industrial and application-oriented R&D. Funding responsibility for basic science was left to the individual European governments.

The international S&T policies during this phase continued the prior thematic focus on nuclear and particle physics, space research, and molecular biology. Switzerland secured its participation in the International Energy Agency (IEA) and the International Energy Programmes (IEP) in 1974, in the European Space Agency (ESA) in 1975, in EURATOM in 1979, in the European Southern Observatory (ESO) in 1981, the European Synchrotron Radiation Facility (ESRF) in 1988 and the Institute Laue-Langevin (ILL) in 1988. Switzerland also participated in EUREKA since its inception in 1985, which was directed at market-driven technology projects. Switzerland still participates in these European programmes in the present day. They are a legacy of the international S&T policies between 1973 and 1990.

8 The Framework Agreement on Scientific-technological Cooperation between Switzerland and the European Communities of 1986.

The Federal Office for Education and Science, established in 1979, acted as federal agency in charge of international S&T policies. It was supplemented by another agency at the end of this phase; the Group for Science and Research was formed at the Federal Department for Home Affairs in 1990. In this year, Switzerland also dispatched its first Scientific Councillor to Brussels.

Swiss S&T policies in the field of development cooperation were formalised in the Federal Law regarding International Development Cooperation and Humanitarian Aid of 1976. The 'Service for Technical Cooperation' at the Federal Political Department changed its name to the Directorate of Development Cooperation and Humanitarian Aid (DCA). Several international agreements were signed with developing countries during this phase.

By the end of the 1980s, Switzerland had laid the foundations for its future international S&T policies with Europe. The approval by parliament of the framework agreement between Switzerland and the European Commission of 1986 gave the Federal Council a formal mission to pursue international S&T policies with Europe. Swiss participation in European S&T programmes has remained part of its heritage to the present day. But it would take another decade of negotiations for Switzerland to achieve full association with the FPs of the EU. European S&T policies were at the brink of taking off; the European Union had only just taken on R&D into its common policy agenda with the European Act of 1987.

2.3 Participation in the Framework Programmes of the EU (FPs) (1990–2004)

The third phase of international S&T policies in Switzerland (1990 to 2004) was focused on negotiating participation in the framework programmes of the European Union. The years between 1990 and 2004 cover three framework programmes and the beginning of the sixth framework programme. Switzerland participated as third-party country in the third, fourth and fifth framework programmes. By the end of this phase, in 2004, Switzerland had achieved full association with the sixth framework programme. International S&T policy in Switzerland during this phase primarily meant S&T policy relations with Europe.

European S&T policy to govern the development of the framework programmes underwent profound transformation between 1990 and 2004. The first two framework programmes had been proposed based on a funding mechanism provided by the Single European Act of 1987, which permitted the European Commission to become active in S&T policy. This authority was expanded in 1992 with the Maastricht Treaty, which empowered the European Commission to undertake initiatives to ensure coordination between member states[9].

In December of the same year, the Swiss population rejected membership in the European Economic Area (EEA) in a public vote. The Federal Council had commenced negotiations for the accession to the EEA together with other member states of the European Free Trade Association (EFTA) earlier that year. After the demise of these negotiations for EU membership at this early phase, further relations with the EU were pursued by developing bilateral agreements (FDFA, 2016). Further negotiations for Swiss participation in the European FPs thereafter were conducted as part of the first and second bilateral agreements between Switzerland and the EU.

In the following years, the FPs became the main instrument of a common European S&T policy and continually advanced their focus, budget and procedures. Various EU treaties (such as the Amsterdam Treaty of 1997, the Lisbon Strategy of 2000 and the Treaty of Nice of 2001) led to decision-making reforms amidst the continuing EU enlargement. The first three framework programmes had a budget of 3.3, 5.4 and 8.7 billion Euros (equivalent) and collectively provided support mainly for the natural and technological sciences in the areas of ICT, industry and materials, life sciences, natural resources, energy and environment, and SMEs. The fourth framework programme moved beyond industry-focused research and saw a rise in budget to 13.1 billion Euros (equivalent). It included three cross-cutting programmes on international cooperation, distribution and application of results, and edu-

9 The Maastricht Treaty of 1992 laid the cornerstone for the European Union; the European Economic Community EEC was renamed European Community (EC), and its powers were extended to non-economic areas (FDFA, 2016).

cation and mobility. The fifth framework programme with a budget of 14.9 billion Euros (equivalent) restructured European research funding and focused on four thematic priority areas and three horizontal measures (Prange, 2003). It involved a shift in S&T policy that moved from a focus on technological development towards a more comprehensive innovation policy. The sixth framework programme with a budget of 19.1 billion Euros (equivalent) pursued the objective of establishing a European Research Area (ERA) and effected a major consolidation of European S&T cooperation. It was structured into seven thematic priority action areas and four horizontal measures to support structural weaknesses of European research and innovation activities.

Following the rejection of the Swiss population in 1992 to join the EEA, Swiss Parliament gave the Federal Council the clear mission to pursue participation in the framework programmes on the basis of bilateral agreements. A period of intense negotiation followed between Switzerland and the European Commission and member countries of the European Union, to secure Swiss participation in the framework programmes. These efforts formed part of bilateral negotiations between Switzerland and the EU in seven key policy areas and came to be concluded after seven years as the first bilateral agreements in 1999. The package of seven sector-based agreements included a Research Agreement that provided for Swiss participation in the FPs of the EU. The bilateral agreements were approved in a referendum and entered into force in June 2002.

However, the Research Agreement only settled Swiss participation in the 5th framework programme (and participation in the fifth framework programme EURATOM) and new negotiations between the EU and Switzerland for Swiss participation in the sixth FP were concluded by June 2003. The new Research Agreement elevated Switzerland's participation in the FPs from third party to full association. The arguments of the Federal Council in favour of this agreement included the reputation of Switzerland within the emerging European research area; and its influence in European S&T policies through the presence of Swiss observers and experts in the various committees. The full association of Switzerland to the FPs secured access to information and the opportunity to influence the design and implementation of present and future framework programmes. The second bilateral agreements were signed in 2004.

For much of this period, the negotiations for participation in the European framework programmes were tied to the first bilateral agreements and therefore formed part of a process to determine Switzerland's non-member status in the emerging European Union. The international S&T policies of Switzerland during these years were oriented towards keeping pace with the emerging European S&T policies and their expanding initiatives. Accordingly, the international S&T policy instruments of Switzerland were tied to the negotiations for the entire package of bilateral agreements. The mixed research committee of Switzerland and the European Communities (EC), which had been established in the Framework Agreement on Scientific-technological Cooperation between Switzerland and the EC in 1986, assumed a leading role in the negotiation processes.

Research cooperation with the EU during this phase continued on the basis of the Framework Agreement on Scientific-technological Cooperation between Switzerland and the then European Communities of 1986. But the funds for participation in the FPs of the EU had to be approved by parliament. The Federal Council issued several dispatches to request funds for the FPs over these years. Swiss Parliament approved all of these requests. But they were also subject to the general approval of the bilateral agreements by the Swiss population. From 1992 the project costs for Swiss participants in the FPs were financed by the Group for Science and Research, but had to be evaluated and audited both by Swiss public administration and the EU.

Swiss participation in the EU framework programmes was considered a matter of national S&T policy priority during this phase. The Federal Council's research policy objectives for the years 2000 to 2003 included the 'integration of the Swiss higher education network in international cooperation' as an overarching goal. This category aimed at securing participation in the FPs of the EU, in COST, EUREKA and other international research organisations. Also, for the first time these objectives included a focused upgrade of bilateral and multilateral cooperation, especially with developing and transition countries (ERI-Dispatch 2000–2003:302).

During this phase, Switzerland expanded its tools of science diplomacy. In 1986, a Swiss Science Councillor was sent to Tokyo. In 1990, a Swiss Science Councillor was dispatched to Brussels, and the Swisscore offices were established five years later in 1995. In addition, the first three Swissnex Houses were launched in Boston (2000), San Francisco (2003) and Singapore (2004) respectively.

At the beginning of this phase, Switzerland began participating in the FPs as third party and depended on the invitation of project leaders in EC countries. By the end of this phase, Switzerland had successfully expanded its scope of participation in the FPs from the research level to the S&T policy level. Its full association allowed it to participate in various strategic S&T policy committees of the FPs.

2.4
Cooperation with emerging and developing countries, and full association in the FPs of the EU (2004–2017)

Two events marked a turning point that would set the scene for a new era of international S&T policies after 2004: Switzerland's full association with the FPs of the EU in 2004, and the Federal Council decision to develop and expand privileged relations with priority countries outside the EU in 2005. The Federal Council issued a decree that ordered an interdepartmental working group to be set up to write an international strategy for education, research and innovation.

Switzerland's international S&T policies with Europe between 2004 and 2014 were shaped by its new status as a fully associated country in the sixth and seventh FPs. This status gave Switzerland access to a number of S&T policy committees of the FPs and expanded its participation at various levels. Up until 2014, when Switzerland lost this status and was provisionally downgraded to a third party, its international S&T policies with Europe required less strategic attention than in previous decades. This changed temporarily until 2016, when Switzerland resumed full association to the FPs. For most of the recent phase, however, Switzerland's international S&T policies with Europe were up and running and the country could reap the results of decades of negotiation, having secured not only participation in European S&T cooperation but also participation in S&T policy-making commissions of the EU.

The Federal Council decision to expand relations to priority countries refocused Swiss international S&T policies to the new geographical areas of emerging and developing countries. During the next decade, Switzerland launched a number of new instruments for international S&T policies and started developing S&T policy documents that sought to address the challenges of globalisation at various institutional levels. The Federal Council issued an International ERI-Strategy (IERIS) in 2010. Thereafter, the comprehensive revision of the Research Act in 2012 provided a new legal framework for international S&T policies. These developments impacted on the entire institutional S&T landscape, and gave rise to the advent of new committees, commissions and delegations tasked with international S&T policy matters.

This major transformation of Switzerland's international S&T policies coincided with the formation of a single federal agency for education, research and innovation, the current State Secretariat for Education, Research and Innovation (SERI). At the beginning of this phase, in 2005, two federal agencies were merged to form the State Secretariat for Research (SER) at the Federal Department of Home Affairs[10]. Only a few years later, another major merger of federal agencies was effected: the SER was combined with the Federal Office for Professional Education and Technology (OPET) of the Federal Department of Economic Affairs (FDEA) to form the State Secretariat for Research and Innovation (SERI) at the newly established Federal Department of Economic Affairs, Education and Research (EAER). International S&T policies are administered by two SERI divisions; the division for International Relations (responsible for bilateral relations and the Swissnex network) and the division for Research and Innovation (which includes, among others, the three administrative units EU Framework Programmes, International Research Organisations and International Research and Innovation Programmes)[11]. The SERI is also responsible for the Space Office, which is in charge of international space research.

The new instruments for international S&T policies for emerging and developing countries were generated during this major institutional reshuffling of federal agencies and complete revision of the legislative framework. The new legal framework, however, did not enter into effect from one day to another but was gradually phased in through a cluster of related Acts, Ordinances, Organisational Ordinances, and Decrees. The legal regulations relevant to international S&T policies were spread across various components of this cluster. These components have already undergone further revisions since the new Research Act of 2012.

All of the new instruments for S&T cooperation and science diplomacy with emerging and developing countries had already been launched before the major legal revision; in fact, they were one of the driving forces for the legal amendments. They included bilateral research programmes with priority countries, which were initiated in 2008, following two prior pilot projects with China and India. The geographical focus of the initial programmes on China, India, Japan, Brazil, South Africa, South Korea, Russia and Argentina has largely been retained to this day. The governance and management structures of the bilateral research programmes, however, have undergone several transformations. The original Leading House governance model gradually shifted governance responsibilities from Swiss higher education institutions to the SNSF.

10 The Group for Science and Research (GWF) (1990) and the Federal Office for Education and Science (1979).

11 https://www.sbfi.admin.ch/sbfi/en/home/the-state-secretariat-for-education--research-and-innovation/organigramm-sbfi.html, accessed 14.3.2018.

The Swissnex Houses were also developed as a new tool for international S&T policies during this phase. The first Swissnex Houses in Boston and San Francisco had already been established prior to this phase (in 2000 and 2003 respectively) but the subsequent extension of these prototypes to emerging and developing countries took place after 2004 (Singapore 2005–2015, Shanghai 2008, Bangalore 2010/11, and Rio de Janeiro 2014). In parallel, the number of Science Councillors to emerging and developing countries was enlarged. A new concept was introduced to label the new global spread of Science Councillors and Swissnex Houses: the 'external network for education, research and innovation'. Swiss science diplomacy during these years also included exploratory S&T missions of high profile Swiss delegations to emerging and developing countries. Many new international S&T agreements were signed over the past decade. Also, a new ten-year funding scheme was launched jointly by the Swiss Development and Cooperation Agency (SDC) at the FDFA and the SNSF in 2012, the Swiss Programme for Research on Global Issues for Development (r4d).

These new instruments for international S&T policies were impacted by the shifting legal and institutional circumstances. Public administration was challenged to accommodate and develop the newly launched international S&T policy initiatives against this unstable background. Furthermore, the temporary downscaling of Switzerland in the FPs of the EU between 2014 and 2016 required exceptional policy attention. Likewise, institutions and agencies outside of public administration struggled to keep up with these administrative and legal changes and their effect on the instruments of the new international S&T policies. Overall, therefore, the development of international S&T policies in response to the new global dynamics of knowledge has presented an unprecedented challenge both to federal administration and to the wider S&T landscape of Switzerland.

New features and mechanisms

3

New features and mechanisms

This chapter investigates the new features and mechanisms that characterise the current era of international S&T policies in Switzerland and set it apart from previous phases. It considers changes in legislation; research programmes; science diplomacy initiatives; international agreements; international strategies; international committees, commissions and delegations; and policy development.

At the end of this chapter, the features and elements of the new international S&T policies are investigated using the conceptual lens of a policy cycle. It consists of the five stages of agenda-setting, policy formulation, decision-making, policy implementation and policy evaluation. Mapping the new features and elements into this framework allows us to discern general patterns in the recent developments of international S&T policies in Switzerland. These patterns assist to illustrate how Switzerland has responded to new global forces in the international political economy of science. The expansion of international S&T policies in Switzerland during these years forms part of a wave of new international S&T policies that has swept across European S&T over the past decade. This wave of change has occurred at a rapid pace and signifies efforts to come to terms with the new international political economy of knowledge. However, national responses have differed considerably. The following discussion of the new features and mechanisms of the response particular to Switzerland provides the background for identifying strategic issues and key questions in need of future attention in Chapter 4.

3.1 Legal framework

The legal conditions for developing international S&T policies are determined by the rules and regulations of the new Research and Innovation Promotion Act (RIPA)[12], its associated ordinances and other related legislation[13]. The RIPA underwent comprehensive revision in 2012 that concerned the entire ERI landscape. The rapidly changing circumstances for international S&T were one of the driving forces for the thorough legal revision of this area of public policy[14].

The new legislative framework has vested responsibilities for a range of important issues affecting international S&T policies with the SERI, including international agreements[15]; performance and service level agreements; planning procedures for S&T policy; and the financing of a variety of potential recipients of federal funds. Consultation, monitoring and controlling mechanisms for international S&T policies are not specified in the RIPA[16].

Planning procedures to develop international S&T policies are not addressed in the new legislation, but by default come to rest with the agency in federal administration that is tasked with their implementation, the SERI. The new legal framework allows for the delegation of certain responsibilities and financial contributions from the SERI to a range of institutions that previously had not been consigned policy-making responsibilities for international policy matters. However, the delegation of competences is performed by legal principle only, without specifying processes and finances.

Since policy formulation is in principle not the task of federal administration, the SERI's response to these new responsibilities has been to delegate decision-making competences to other agencies by way of performance agreements and service-level contracts. In particular, the SNSF has been assigned policy-making and decision-making competences on international policy issues[17] that national research-promotion agencies have not typically been vested with. The SERI has signed performance or service-level agreements with the SNSF, the Swiss Academies, the Swissnex Houses, Swisscore in Brussels, the Science Councillors, the Leading Houses of the bilateral research programmes[18], and the ILO-Office.

As a result, the new legislative framework after 2012 has caused a steep increase in performance and service-level agreements by the SERI for international matters. In addition, the scope of institutions that may be bound by such agreements and contracts with the SERI, has been expanded[19]. However, no legal requirements are formulated on the public availability of these agreements and as a consequence, most of them are not publicly available. Since these agreements specify competences and procedures essential to the international S&T policies of Switzerland, this negatively affects the ability of the various actors involved to navigate the transforming landscape[20].

The current legislation does not regulate the process of allocating funds to international S&T cooperation and science diplomacy. Budget applications for international S&T policy instruments and activities are presented to Parliament in the ERI-Dispatches. The ERI-Dispatches frequently refer to the International ERI-Strategy (IERIS) of 2010 to make a case for claiming funds for international S&T activities. The IERIS, however, is a legally non-binding document, and in any case does not deliver guidance on the distribution of federal funds.

12 The RIPA was concluded on 14 December 2012 and entered into effect on 14 January 2014 (420.1: Bundesgesetz vom 14. Dezember 2012 über die Förderung der Forschung und der Innovation, FIFG).

13 These include the Ordinances associated to the Research Act (2013), the Ordinance on the participation in the R&I Framework Programmes of the EU (2014), the Federal Act on the Federal Institutes of Technology (legal foundation of the ETH Domain, esp. the revision of 2015), and the associated Ordinances on the ETH Domain and the ETHZ and EPFL, the Federal Act on the promotion and coordination of higher education institutions (2011), and its associated Ordinance (2016), and the Agreement on the Cooperation of the Swiss Confederation and the Cantons in the area of higher education (2015).

14 11.069: Botschaft zur Totalrevision des Forschungs- und Innovationsförderungsgesetzes vom 9. November 2011.

15 The RIPA confers to the Federal Council the authority 'to conclude international treaties on international collaboration on research and innovation' (Article 31, paragraph 1). The Ordinance to the RIPA (O-RIPA) transfers these competences to the EAER. It specifies the range of this authority to 'international agreements of limited scope' and 'memoranda of understanding' in the area of international research and innovation cooperation (Article 42, paragraphs 1 and 2). It also rules that the EAER can delegate these competences to the SERI (Article 42, paragraph 3). The Organisational Ordinance of the EAER to the O-RIPA (the O-RIPA-EAER), in turn, effects this transfer of competences to the SERI.

16 The Federal Council is only obliged to consult with 'specific research bodies, the Swiss University Conference or the ETH Board' if the agreement under consideration 'affects' their 'tasks', and transfer of this specification is not considered in the V-RIPA and the V-RIPA-EAER.

17 ERI-Dispatch for the years 2013 to 2016:8852.

18 The Ordinance to the RIPA instructs the SERI to draw up performance agreements with the Leading Houses of the bilateral programmes outside of international programmes and organisations (Article 52, paragraph 2).

19 The SERI is authorised to sign service level agreements with 'non-governmental research bodies and other beneficiaries' (Article 8, paragraph 1) and may transfer these competences 'to the EAER or to the competent administrative unit' (Article 8, paragraph 2).

20 For example, the new legislation authorises the EAER to determine financial contributions for the implementation of bilateral research programmes with priority countries within the approved credits of the period. These financial contributions are to be specified in the performance agreement with the SNSF (O-RIPA Article 52, paragraphs 1 and 3). But the last two performance agreements between the SERI and the SNSF (2013 to 2016, 2017 to 2020), both referred to a 'supplementary protocol' between the SERI and the SNSF for the specification of these tasks and financial contributions. Since this supplementary protocol is not publicly available this information is not accessible to the broader Swiss ERI landscape.

The new legislative framework instructs the Federal Council to take appropriate measures to review and coordinate national and international promotion policies[21]. Furthermore, the RIPA places the responsibility on the Federal Council to achieve coherence between international cooperation on research and innovation and Switzerland's economic foreign policy, development policy and general foreign policy[22]. The instruments and procedures required to carry out this responsibility, however, are not stipulated in the new legal regulations.

Finally, the new legislative framework does not ask for consultation with other federal agencies vested with responsibilities for international S&T policies. In particular, the FDFA is commissioned to coordinate sectoral foreign policies. Its Sectoral Foreign Policies Division is instructed to support the Federal Council to define specific foreign policy objectives. It is further vested with the responsibility to guarantee coherent positions in specific policy areas and efficient coordination between the FDFA and the relevant specialist departments in their pursuit of Switzerland's foreign policy interests[23]. But the distribution of responsibilities between the SERI and the FDFA is not settled in the new legislation[24]. This results in parallel but separate line responsibilities for the FDFA's agencies involved in international S&T policies. The Swiss Development and Cooperation Agency (SDC) of the FDFA is a case in point. Its research portfolio builds on a long tradition of cooperation with emerging and developing countries and in principle implements the 2005 Federal Council decision to expand international S&T policies to these geographical areas. However, the activities of the SDC are not addressed in the new legal framework, but continue to be bound by the Act on International Development Cooperation and Humanitarian Assistance of 19 March 1976 and its associated Ordinance of 1977[25], as well as to the Organizational Ordinance of the Department for Foreign Affairs (FDFA) of 2011[26].

Overall, the new legislative framework has impacted the development of the new initiatives for international S&T policies after 2012. Its focus has been on the institutional distribution of decision-making responsibilities and on regulating the structural conditions for the bilateral research programmes.

21 In principle, the new RIPA adhered to the principle of self-coordination that had already guided the Research Act of 1983. But the importance of aligning national and international R&I promotion had risen in the face of growing international competition. The Federal Council's mandate to take additional coordination measures therefore only applied in face of an actual need to complement gaps that arise in the self-coordination of these institutions. This need was identified for the international research promotion of the Swiss Confederation. Botschaft zur Totalrevision des Forschungsgesetzes, 2011:8860.

22 RIPA, Article 41, paragraph 3b.

23 https://www.eda.admin.ch/eda/en/home/fdfa/organisation-fdfa/directorates-divisions/directorate-political-affairs/asa.html, accessed 22.11.2017.

24 At the moment, no effective agreement between the SERI and the FDFA is in place. An outdated agreement is referenced by the SERI in the IERIS and other policy documents, entered into by the Directorate of Corporate Management of the FDFA and Group for Science and Education, one of the predecessor organisations of the SERI in December 2002.

25 974.01: Verordnung vom 12. Dezember 1977 über die internationale Entwicklungszusammenarbeit und humanitäre Hilfe.

26 Organisationsverordnung für das Eidgenössische Departement für auswärtige Angelegenheiten (OV-EDA) vom 20. April 2011.

3.2
Research programmes

Two major research programmes were launched to expand Swiss S&T cooperation with emerging and developing countries in 2008 and 2012 respectively; the bilateral research programmes and the Swiss Programme for Research on Global Issues for Development (the r4d Programme)[27].

The bilateral research programmes

Since 2008, Switzerland has been running bilateral research programmes to promote cooperation with a selection of priority countries, consisting of the emerging economies (the BRICS), Japan and South Korea. They were based on the Federal Council decision in 2005 to develop and expand its bilateral relations to non-European countries. Pilot programmes had already begun with China (2004–2007) and India (2005–2007). The geographical expansion and allocation of federal funds required an amendment of the Research Act.

The bilateral research programmes, together with other 'pilot activities' and the Swissnex Network, are considered as the main instruments of the Swiss government for international cooperation with foreign partners in the fields of science and innovation outside of Europe. This instrument was not intended to promote S&T cooperation with other 'scientifically strong' countries such as 'North America and Singapore'; this task was assigned to the Science Councillors[28].

The profile of the bilateral research programmes has changed considerably since their inception some ten years ago. In their short history they have undergone changes in governance and management, administration, funding promotion categories, financing procedures and legal status. Other aspects have persisted, such as their principles of cooperation, which are described as 'mutual benefit, joint financing and scientific excellence' (SERI, 2015:8). However, since no annual reports, financial reporting requirements, or independent evaluations are available (with the exception of an evaluation commissioned by the SER in 2011) the decisions and processes leading to these changes cannot be traced.

The bilateral research programmes introduced an innovative new management model which vested governance and project leadership responsibilities with Swiss higher education institutions in the form of Leading Houses for priority countries or regions. This model envisaged consultation with the CRUS and the UAP, and partnerships with the SNSF, the ETH-domain, and the CTI, and business. The bilateral research programmes were presented as a complementary initiative to the research-promotion programmes of the SDC, which at the time were also active in some of these emerging and developing countries.

27 In principle, the full association of Switzerland to the FP would also qualify as a new instrument for international S&T cooperation for these years, but it has already been described in the previous chapter (Chapter 2.4).

28 ERI-dispatch, 2008–11:1344.

Swiss 'National Steering Committees' and Joint Committees governed the Leading House model during its first three years. The National Steering Committees were appointed for most programmes with representatives from public administration, the SNSF and the Leading Houses. Joint Committees were established for each priority country with representatives from both countries (Lepori & Dunkel, 2011). The governance model secured that projects were evaluated and decided on by both countries[29]. Several research-promotion schemes were offered under the auspices of these committees and universities established administrative structures for this purpose.

After 2011, the governance, management, administrative and evaluation responsibilities of the Leading Houses were transferred to the SNSF. This transfer was based on a report that recommended to standardise and simplify procedures and increase efficiency (Lepori & Dunkel, 2011) and to separate evaluation and management from strategic functions[30]. Also, while the bilateral programmes prior to 2011 involved a range of funding categories, including exchange programmes, all of these instruments for research promotion were discontinued to standardise the types of funding instruments. These decisions effected changes in the Leading House model and resulted in revised performance agreements between the SERI, the SNSF and the Leading Houses respectively[31].

The role and locations[32] of the Leading Houses have recently been modified again. The new legislative framework has formalised the responsibility of the SERI to appoint national steering committees and Leading Houses[33]. It also requires the details of the bilateral research programmes to be specified in performance agreements with the SNSF. However, at the moment, these details are not included in the regular performance agreement between the SNSF and the SERI, but in an additional protocol, and there is no mention of national steering committees. The Leading Houses have received a new status as 'liaison offices' for six geographical regions (North Africa and Middle East; Sub-Saharan Africa; Latin America; East and Southeast Asia; Russia and the Commonwealth of Independent States (CIS); and Indian sub-continent and Iran). The bilateral research programmes are now run by calls for proposals for Joint Research Projects (JRP) with the BRICS, Argentina, Japan and South Korea by the SNSF. Funds for the bilateral research programmes are integrated in the SNSF's budget application to parliament through the ERI-Dispatch. The calls for proposals for the various countries need not follow regular intervals and may be thematically focused[34]. The SERI currently also undertakes 'fact-finding' missions to developing countries in cooperation with the Leading Houses[35]. These also run under the category of bilateral research programmes but do not aim to formalise new research programmes. As a result of these changes, no comprehensive statements are publicly available anymore on the total expenditure for the bilateral research programmes and the Leading Houses[36].

Federal decision-making on the governance, management, and administration of the bilateral programmes and their Leading House model since the complete revision of the legal framework has not been assessed or documented. Current legislation requires no regular financial statements, public reporting, monitoring tools and evaluation procedures. The performance agreements of the SERI with the Leading Houses and the additional protocol on bilateral research programmes between the SERI and the SNSF are not publicly available.

The shortage of information surrounding the modification of the Leading House model appears to have held back the establishment of stable strategic, planning and administrative procedures at Swiss higher education institutions. The bilateral research programmes with emerging and developing countries were launched as an instrument to build a tradition of cooperation and exchange with countries that displayed significant scientific and technological development potential. Changing short-term missions and specifications for the Leading Houses – ranging from policy making to administrative duties – have created uncertain conditions at Swiss higher education institutions and have impeded the development of stable institutional structures for international S&T policies.

29 While both countries ran parallel evaluations, the evaluation processes for the Joint Research Programmes were jointly managed by the Leading Houses and the SNSF: proposals were submitted via the SNSF, the national Steering Committee made recommendations, and these were transmitted to the Joint Committees for final decisions. All other programmes and smaller instruments were managed by the Leading Houses and supported by international experts for scientific peer review.

30 The new mission of the Leading Houses was to 'prospect […] new regions and countries that may be of interest for intensifying bilateral research cooperation with the aim of developing the international ERI strategy' (SERI, 2015:8).

31 The SERI justified these decisions by referring to recommendations that had been put forward in an evaluation of the bilateral programmes in 2011 (Lepori & Dunkel, 2011), following instructions made in the ERI-Dispatch 2008–11.

32 The first seven Leading Houses appointed by the SERI included EPFL, ETH Zurich, the University of Zurich, the University of Basel, the University of Lausanne, the University of Bern, and the University of Geneva (Lepori & Dunkel, 2011). Currently, the following Leading Houses are listed on the SERI websites: the University of Applied Sciences and Arts Western Switzerland (HES-SO) (North Africa and Middle East); Swiss Tropical and Public Health Institute (Swiss TPH) (Sub-Saharan Africa); University of St Gallen (HSG) (Latin America); ETH Zurich (East and Southeast Asia); University of Geneva (Russia and CIS); Zurich University of Applied Sciences (ZHAW) (Indian sub-continent and Iran).

33 The Ordinance to the RIPA, and the Organisational Ordinance of the EAER to the RIPA contain an article on the procedures for joint project calls with priority countries and regions (Article 52). It vests the authority to appoint national steering committees and Leading Houses (in consultation with swissuniversities) with the SERI. The SERI is ordered to enter into performance agreements with the Leading Houses and remains responsible for those geographical regions not covered by them.

34 http://www.snf.ch/en/funding/programmes/bilateral-programmes/Pages/default.aspx, accessed 16.12.2017.

35 The SERI has recently issued a report on the 'Bilateral Measures of the International ERI Strategy of Switzerland', containing a short section on 'bilateral programmes with countries outside of Europe' (SERI, 2015).

36 While the first two budget phases of the bilateral programmes had presented financial figures for the category 'bilateral programmes' (43 million CHF for 2008–11 & 11.3 million CHF for 2012; 52.7 million CHF for 2013–2016), they no longer appeared as a separate category in the last ERI-Dispatch 2017 to 2020.

The r4d Programme

In 2012, the SNSF and the SDC launched a new ten-year joint funding scheme, the Swiss Programme for Research on Global Issues for Development (the r4d Programme). The geographic focus of the r4d Programme is much broader than that of the bilateral research programmes, and includes African, Asian and Latin American countries. It aims at solving global problems with a focus on least developed, low and middle-income countries[37]. Five thematic modules structure the programme (social conflicts, employment, food security, ecosystems, public health) and a sixth module issues calls for open research.

The r4d Programme stands out as a new instrument for international S&T policies that bridges two sets of research quality requirements. It is administered by the SNSF, but its funding scheme stipulates a number of conditions that are not typically required for SNSF project applications. The funding scheme supports research partnerships, aims at providing knowledge for policymakers, combines scientific and development-relevant knowledge (SDC & SNF, 2016:5), is directed at inter- and transdisciplinary research approaches, and requires strong emphasis of the projects on communication and implementation of research results. One of the key features of this new instrument is its equal consideration of research projects' scientific quality and developmental relevance. The criteria for developmental relevance were influenced by the principles and questions for research cooperation as spelled out in the Guide on Transboundary Research Partnerships of the Commission for Research Partnerships with Developing Countries (KFPE). This Guide builds on years of experience in development cooperation and aims to provide guidance on practical problems and opportunities in cooperative projects.

The programme is operationally managed at the SNSF and its National Research Council is authorised to make final decisions on the proposals. A joint Steering Committee with members from the SNSF and the SDC provide strategic management and supervision. Project leadership is vested with Swiss institutions but at least one research group and a group of stakeholders have to participate.

The r4d Programme is an outcome of the evaluation and redefinition of the SDC's research policy after 2010, and it is the only cooperative international S&T policy instrument between SERI and the FDFA. Therefore, the appraisal of its results and effectiveness are likely to influence Switzerland's strategic S&T policy decisions of the next phase. The simultaneous consideration of traditional quality criteria that are applied for scientific and development projects respectively, is recognised as one of the key challenges for the new generation of S&T policies. The lessons learned in this pilot programme and their translation into future cooperative funding schemes for these global regions therefore are likely to be an important factor to determine Switzerland's competitive position in the growing global enterprise of research cooperation with emerging and developing countries.

37 http://www.r4d.ch/, accessed 29.11.2017.

3.3 Science diplomacy

Switzerland has increased its science diplomacy activities with emerging and developing countries since the beginning of the new millennium. Two instruments have been employed for this purpose: the external network for education, research and innovation, consisting of the network of science councillors and the Swissnex Houses; and exploratory S&T missions.

The 'external network for education, research and innovation'

The 'external network for education, research and innovation' labels two kinds of instruments currently employed for Swiss science diplomacy: the network of science councillors and the Swissnex Houses. Switzerland has been active in science diplomacy since the late 1950s, when it appointed a scientific attaché to Washington in 1958. Over the years the number of S&T science councillors has increased and their designation and tasks have been modified. By the end of 2017, after a short period of rapid geographic expansion during the last phase of international S&T policy, Switzerland was supporting twenty-eight science and technology councillors across twenty countries. As of 2016, the SERI was financing nine science councillors as well as eleven other staff working part time in the external ERI-network of the FDFA (SFAO, 2016:15).

At the beginning of the new millennium, the traditional foreign science policy tool of science councillors was supplemented by a new instrument: the Swissnex Houses. These were launched at the interface of foreign policy and national S&T policy and are currently located in the United States, China, India and Brazil. The first Swissnex House was created as the 'Swiss House for Advanced Research and Education' (SHARE) in Boston in 2000. Its premises were sponsored by a donation of around 2.5 million Swiss francs to the Swiss Confederation by the Swiss bank Lombard Odier & Cie. The SHARE initiative has been ascribed to the Swiss Science and Innovation Council of the Swiss Embassy in Washington. It was used as a prototype to establish further houses in San Francisco 2003, Singapore 2005, Shanghai 2008, Bangalore 2010/11, and Rio de Janeiro 2014. Swissnex Singapore was discontinued in 2015. The original objective of the Swissnex Houses was to combat 'brain drain' and has shifted to promote 'brain circulation' (SFAO, 2016).

No binding criteria have guided the selection of sites for the Swissnex Houses[38]. Since 2003, plans for future Swissnex Houses were presented in the ERI-Dispatches. Swissnex is not mentioned in the RIPA or its decrees and therefore falls short of an explicit legal basis. As a result, there remains considerable confusion over the reporting and accountability of both, the Swissnex Houses and the Science Councillors, some of which are funded by the SERI.

The SERI is responsible for the technical and operational management of the external network for ERI but both, the science councillors and the Swissnex Houses, are 'administratively integrated' at the FDFA. The Swissnex Houses enter into performance agreements with the SERI for a period of four years. These performance agreements refer both to the ERI-Dispatch and an outdated agreement between the SERI and the FDFA[39]. According to the SERI, the SERI's responsibilities are carried out in close coordination with the FDFA (SBFI, 2015:9). Furthermore, the CEOs of the Swissnex Houses also individually sign *lettres de mission* with the Head of International Relations of the SERI and the Heads of the Swiss Missions abroad. These *lettres de mission* set the annual objectives but do not refer to the performance agreements[40]. A Swissnex committee advises the State Secretary on 'strategic issues relating to the Swissnex Network'. The tasks and responsibilities of this committee, however, are not specified and no annual statistics are published on the budget and expenditure of the Swissnex network.

The Swissnex Houses are a balancing act of international collaboration across public and private institutions and funding sources[41]. For this reason, they have been susceptible to critique with regard to their formal integration into national S&T structures. But their flexible and pioneering profile stands out as an innovative new tool to experiment within uncertain and rapidly changing international S&T conditions. The Swissnex model has received international praise and there have been attempts by other countries to reproduce it. It is the only new instrument for international S&T policies that has not been assimilated into existing national S&T policy structures.

Exploratory S&T missions

Between 2004 and 2017, a series of exploratory S&T missions to non-European countries were carried out under the lead of the SERI. This new tool for international S&T policy will also be employed during the ERI period 2017 to 2020. Exploratory missions are accompanied by high-ranking scientific delegations. They differ in status and profile from diplomatic S&T visits by the State Secretary to other countries, which take place without such delegations. There are indications that the number of these missions has increased steadily over the past few years, but there are no comprehensive records on the countries visited by Swiss delegations over these years. The following countries are mentioned in the Foreign Policy Report and press releases respectively for the years 2015, 2016 and 2017: South Africa, Côte d'Ivoire, Guinea, Argentina, Brazil, USA, India, China in 2015; China, Iran, Lebanon, Indonesia, Sudan, Ethiopia, India, Germany, Australia and Kenya in 2016; and Russia, India, Austria and Tunisia in 2017 (FDFA 2016:1408, FDFA 2015:743).

The recent increase in Swiss exploratory S&T missions to emerging and developing countries indicates that they have qualified as a successful tool for international S&T policies. The last two ERI-Dispatches have stressed the need for exploratory S&T missions to expand bilateral relations and cooperation in ERI. Visits by delegations, bilateral meetings and information exchange are listed as requiring increasing staff resources to coordinate, control and carry out these visits.

The new legislation only makes general provision for appointing delegations that confer to the SERI the authority to appoint Swiss delegations to international organisations, programmes and cooperation projects[42]. Barely any information is available on the purpose and specific objectives of these visits, the appointment and composition of the delegation, their costs and financial sources, and the decision-making processes leading to the particular selection of countries. Therefore, the function and role of this new tool in the newly emerging national landscape of international S&T policies are difficult to appraise. These circumstances impede access and active participation by the entire spectrum of the Swiss S&T community in this new instrument.

38 The performance audit of Swissnex conducted by the Swiss Federal Audit Office (SFAO) in 2016 states that decisions on new Swissnex locations in the past have not been based on site evaluations (SFAO, 2016:16). The recent SERI publication, 'Roadmap for the development of the Swissnex Network' (2015), on the other hand, claims that these decisions follow the geographical focus areas of the international ERI strategy of 2010 (SBFI, 2015:12).

39 The agreement was signed by the Directorate of Corporate Management of the FDFA and the Group for Science and Education, one of the predecessor organisations of the SERI. This agreement is dated 5 December 2002 (SFAO, 2016:28).

40 This SFAO evaluation in 2016 suggested that this reporting system be revised and a new agreement be put into place between the SERI and the FDFA (SFAO, 2016).
More than 60 per cent of the financing of the Swissnex Houses is currently covered indirectly with federal funds (SFAO, 2016:33).

41 More than 60 per cent of the financing of the Swissnex Houses is currently covered indirectly with federal funds (SFAO, 2016:33).

42 The O-RIPA (Article 43) assigns to the SERI the competence to re-elect or renew Swiss Delegations in the Committees of international organisations, programmes and cooperation projects. The SERI is instructed to invite other federal and research agencies to propose participants and experts for these delegations.

3.4 International agreements

Over the past decade, the number of international agreements and treaties on S&T cooperation has increased considerably. These agreements differ from those entered prior to the Federal Council decision in 2005 to expand its focus to non-European countries. Most of the agreements in the twentieth century had concerned participation in European S&T enterprises, organisations, or research programmes (FP, COST, EUREKA). Cooperation agreements with emerging and developing countries prior to the turn of the millennium such as, for example, with India in 1966 or with Kenya in 1970, aimed at technical or development cooperation. The basic legal framework for Swiss participation in the FPs was already concluded in the framework agreement between Switzerland and the European Community on scientific-technical Cooperation of 1986 as part of the first bilateral agreements with the EU.

International treaties have also increasingly been concluded by Swiss S&T institutions, such as research-promotion institutions (SNF, Swiss Academies, CTI) and research institutions (ETH-Domain, higher education institutions) during the last phase of international S&T policies.

The Swiss Federal Council is authorised to conclude international treaties on behalf of the Swiss federal government, as specified in the Research Act (RIPA) of 2012[43]. This authority is subsequently delegated from the Federal Council to the SERI via the Federal Department of Economic Affairs, Education and Research (EAER) by way of two further ordinances[44]. The Federal Council is also authorised to negotiate international agreements on behalf of the Swiss higher education institutions, as laid down in the Federal Act on the Funding and Coordination of the Higher Education Sector.

The general competence of the Federal Council to sign international treaties in the field of S&T had already been established in the first Research Act of 1983, long before the Federal Council decided to expand S&T cooperation to emerging and developing countries. The context and purpose of international agreements thirty years ago were very different from the present day. International agreements have proliferated across public policy domains, and cover an increasing range of issues, purposes, and provisions. The legal vocabulary has multiplied accordingly. As a result, the title and format of the agreements do not necessarily indicate its legal form[45]. A 'Practice Guide to International Treaties' has been issued by the Directorate of International Law at the FDFA (2015) to offer federal agencies guidance on entering into international agreements on behalf of the Swiss federal government.

The new legal framework allows for S&T agreements to cover a wide-ranging list of legal conditions such as budgetary control and audits, intellectual property conditions, arrangements for federal participation in public or private legal entities, and the accession to international organisations. No binding provisions for consultation are specified for the Federal Council, the EAER or the SERI before signing international treaties[46].

In principle, the Federal Constitution confers to the Federal Council the competence of operative leadership in the field of foreign policy (Article 166), authorises the Federal Council to sign and ratify international treaties and orders the Federal Council to submit them to the Federal Assembly for approval (Articles 166 and 184)[47]. The conclusion of international treaties in principle need to be reported on by the Federal Council in its annual Report on the International Treaties to Parliament. However, depending on the kind of agreement, this requirement does not apply. For example, treaties of limited scope are not published in the annual report of the Federal Council. The exact contours of the allocation of responsibilities between Federal Council and Federal Assembly (between the executive and the legislative) remain imprecise and the Federal Council is generally given a wide scope in shaping foreign policy (Waldmann, Belser, & Epiney, 2015:2487/8).

The global context for international agreements has changed, the business of entering into international S&T agreements offers many possibilities and is exceptionally complex. The competences to sign such agreements have been delegated by the Federal Council to a federal agency. But no provisions are made in the new legal framework for S&T to report on the international S&T agreements if they do not qualify for publication in the annual report by Federal Council on the International Treaties to Parliament. This complicates access to this information for Swiss researchers and institutions, who require this information to be able to fulfil their own strategic mission or research tasks.

43 Its authority to delegate these competences, too, had already been formulated in the Research Act of 1983.

44 The Ordinance on the Research Act (O-RIPA, 2013) and the Ordinance of the EAER on the Ordinance to the Research Act (O-RIPA-EAER, 2013).

45 Whereas the Research Act (2012) is only concerned with the 'conclusion of international treaties by the Federal Council', the V-FIFG (2013) and the V-FIFG-WBF (2013) distinguish between 'international treaties of limited scope in the context of international cooperation in research and innovation' and letters of intent for the promotion of cooperation in research and innovation. Both ordinances refer to the Government and Administration Organisation Act (GAOA) of 21 March 1997 (Article 7a, paragraph 2) for a specification of the scope of the term international treaties of limited scope. The EAER Ordinance literally uses the same words as the Ordinance on the RIPA, except for an additional specification for COST.

46 Although the RIPA ends with the clause that 'specific research bodies, the Swiss University Conference or the ETH Board' must be consulted before signing an agreement, this only applies in the event that they are affected by them.

47 In principle, the Federal Assembly of the Swiss Confederation 'shall approve international treaties, with the exception of those that are concluded by the Federal Council under a statutory provision or an international treaty' (Article 166, paragraph 2). Article 7a of the Government and Administration Organisation Act (GAOA) of 21 March 1997 (Status as of 1 January 2016) specifies the powers conferred to the Federal Council to conclude international treaties. It may conclude treaties 'under international law in as far as it is authorised to do so by a federal act or by an international treaty approved by the Federal Assembly' and may independently conclude international treaties of limited scope.

3.5 International strategies

One of the new features of the last phase of international S&T policies has been the appearance of 'International strategies'. At federal level, an 'International ERI-Strategy' (IERIS) was issued by the SER, and endorsed by the Federal Council, in 2010. Several International Strategies were developed subsequent to this document, including the SNSF (2012, 2016), the ETH (2010), the Universities of Applied Sciences (2013), and the University of Zurich. Despite their small number, these international strategies as a whole signal the advent of a new kind of tool in international S&T policy in Switzerland, and may be read as an indication for the need for policy guidance by various kinds of institutions in the Swiss national landscape.

The IERIS explicitly invited the Swiss higher education institutions, particularly the Federal Institutes of Technology, to pursue their own international strategies. It emphasised that other institutions and 'important ERI stakeholders' such as the 'SUC, CRUS, the FIT Council, EDK, KFH, EFHK, Swiss Academies, CTI, SFIVET, numerous foundations and institutes' were 'free to develop and implement their own internationalisation strategies'.

The publication of the IERIS marks a turning point for several reasons. For the first time, an international S&T policy document was issued on behalf of the Swiss Confederation. Prior federal S&T policy documents had been concerned with national S&T policies; an international dimension was typically addressed as an additional or cross-cutting matter. Furthermore, the word 'international' in these documents, in the first instance, had signified Europe. The IERIS explicitly expanded the traditional range of S&T cooperation and science diplomacy to non-European countries, particularly emerging or developing economies. It therefore broke with the standard separation of scientific cooperation and development cooperation as had been traditionally pursued by the Swiss Confederation since the mid-1950s.

The IERIS was drafted by federal administration without stakeholder consultation[48]. An interdepartmental working group was to be convened to write an international ERI strategy and present it to the Federal Council. This document has been widely quoted across the entire S&T landscape in Switzerland. For example, the IERIS is referenced as providing policy guidance for decision-making on the choice of location for Swissnex Houses and science councillors, and the bilateral cooperation programmes[49]. The IERIS is mentioned in the Swiss foreign policy reports (2015, 2016); the SNSF's international cooperation strategy (2012) and the service level agreement between the SERI and the SNSF (2013 to 2016); by the ETH-Domain in connection with the Leading Houses to the bilateral research programmes (ERI-Dispatch 2013–2016:3336, ERI-Dispatch 2017–2020:3163.); in the SDC's research concept for 2017 to 2020; in the internationalisation strategy of the Universities of Applied Sciences (UAS); and in the founding document of the ILO-Office (a joint association between the SERI, the EPLF and the PSI) of 2015.

These references have served various purposes: to justify or legitimise international strategies, policy decisions, country selections, the establishment of institutions, and the introduction of new committees and procedures in the context of international S&T cooperation and science diplomacy. However, the IERIS does not provide the policy substance to inform decision-making on these issues. It delivers no guidance on the measures, financial expenditure and coordination of activities for international S&T policies. Instead, it refers to the ERI-Dispatch for more information on these issues (SER, 2010:21).

By way of this cross-referencing, the IERIS has been presented as a sister document complementing the ERI-Dispatches: implying that the national and international policy scope inevitably complemented one another. The advent of the IERIS implicitly stated a separation of S&T policy formulation into distinct national and international domains. Therefore, despite its formally non-binding legal status, the IERIS assumed the function of an authoritative policy document that accompanies the ERI-Dispatches.

The IERIS also introduced a shift in policy responsibility: It assumed policy power for geographical regions and countries in which the SDC was already active. Accordingly, the policy document, though perhaps unwillingly, has created ruptures in the established separation of competences and responsibilities across various federal departments and agencies, with repercussions across the Swiss research landscape.

To conclude, the IERIS has served as the overarching policy document for the new instruments and policy decisions on international S&T between 2004 and 2017. Over the past decade, the Swiss landscape of research, innovation, science and technology has started to experience and grasp the magnitude of changes induced by a globalising world of science at the national level. Nevertheless, the IERIS has remained the single international S&T policy document at federal level. Accordingly, it was the only document the institutions and agents could turn to for guidance or legitimation in the pursuit of their own strategies and policies. In this way, the document gradually gained a national sphere of influence[50].

48 The IERIS appears to have been formulated in two steps; 'preliminary work in which representatives of the FDFA (DPA, SDC) and the FDEA (SECO) also took part' and the drafting of the document 'by the federal offices directly responsible for education, research and innovation within the FDHA and the FDEA' (SBFI, 2010:4).

49 It is even referred to by the SERI as having guided the choice of location for the Swissnex sites – although the Swissnex Houses in Boston, San Francisco, Singapore, and China had already been established prior to the IERIS, and Swissnex India had already been decided on (SBFI, 2015:12). Nevertheless, the alleged connection of these selections to the IERIS by the SERI was subsequently replicated by other federal agencies, such as the SFAO.

50 The IERIS is currently under revision by federal administration.

3.6
International committees, commissions and delegations

The advent of committees, commissions and delegations to address aspects of international S&T policies is a new feature of the last phase of international S&T policies. Committees have emerged at various levels of the Swiss S&T landscape, including public administration, research agencies, higher education organisations and higher education institutions. But new committees have also been established for science diplomacy initiatives, and for some of the new instruments for bilateral research cooperation with countries beyond Europe. However, despite their wide spread, their impact on federal policies in the domain of S&T has been small. Furthermore, they are disconnected and have not established formal channels of communication or exchange, joint statements or policy documents.

In 2009, the Federal Council ordered the formation of an 'interdepartmental working group' under the leadership of the SERI (then SER) to develop a long-term strategy for international ERI (Federal Council Decree of 21 January 2009) (SER, 2010:4). No empirical evidence has been found for the constitution of the interdepartmental working group[51]. The 'Interdepartmental Coordination Committee' for the Confederation's government research (RIPA Art. 42) has in the past considered international issues, but has issued no official information on these activities.

The SNSF established a 'Specialised Committee International Cooperation (FA IZ)', as a specialised Committee of the National Research Council responsible for cross-divisional matters. The responsibilities of the FA IZ have included 'strategy definition and implementation monitoring'[52]. The SNSF and the SDC have constituted a 'Joint Steering Committee' for the r4d Programme. The Swiss Rectors' Conference (swissuniversities) established an 'International Relations Delegation' in July 2014 and formulated its mandate in January 2015[53]. The 'Swissnex Committee' is described as an advisory committee to 'the State Secretary on strategic issues relating to the Swissnex Network'[54]. The 'International Relations Commission' of the University of Zurich (UZH) was already established in 2003, with the mission of strengthening the university's international standing[55]. Finally, the ILO-Office, too, has established a 'Committee' composed of at least one representative of the involved institutions (SERI, EPFL and PSI), with offices at the SERI.

The new legal framework permits the establishment of 'National Steering Committees' for the bilateral research programmes. However, the wording allows for ambiguous interpretation on whether or not these committees are mandatory[56]. There is no evidence for current operations of such steering committees[57]. According to the O-RIPA-EAER, steering committees are to be chaired and its members appointed by the SERI (Article 16, paragraph b). When the bilateral programmes were launched in 2008, their governing structure had included two types of committees that were convened as part of the Leading House model, the 'Swiss National Steering Committees', and the 'Joint Committees'[58].

51 When the International ERI Strategy (IERIS) was published in 2010, it announced that a proposal would be made to create a permanent interdepartmental working group, 'to ensure information exchange and optimal use of synergies within the ERI system' (SER, 2010:4). The IERIS, however, remains ambiguous on whether an interdepartmental working group had actually been convened. It describes the policy formulation process of the IERIS in two phases; a first phase of 'preliminary work in which representatives of the FDFA (DPA, SDC) and the FDEA (SECO) also took part' and the subsequent phase in which 'federal offices directly responsible for education, research and innovation within the FDHA and the FDEA' drafted the document (SER, 2010:4).

52 The SNSF's first international co-operation strategy for 2013 to 2016 as composed of 'representatives of the main divisions of the National Research Council and external experts where appropriate' (SNSF, 2012:10). Its responsibilities included 'strategy definition and implementation monitoring'. Though the 'Specialised Committee International Cooperation' (FA IZ) is listed on the SNSF website on the National Research Council, it is not, however, mentioned in its current international co-operation strategy (2017–2020) dated February 2017.

53 It is composed of six delegates representing the Cantonal Universities, the Universities of Applied Sciences, the Universities of Teacher Education, and students. Its management is carried out by the General Secretariat of swissuniversities. The International Relations Delegation advises the Board of swissuniversities for matters of importance to the entire higher education system or to individual types of higher education institutions. Its overall objective is to create and maintain optimal framework conditions for the higher education institutions. It is mandated to anticipate developments in international relations, to develop position papers and to supply a basis for decision-making, especially with regard to educational programmes in Europe, the promotion of the Swiss higher education abroad, and international cooperation and mobility. It acts as point of contact for national agencies and institutions. It is also instructed to develop a concept for creating a network on international relations (swissuniversities, 2015:1). The mandate will be evaluated after two years based on two annual reports of the international Relations Delegation (swissuniversities, 2015:1).

54 Its ten members represent the SNSF, the CTI, the FDFA, swissuniversities, a bank (Landolt & Cie), a member of national parliament, and two private technology companies (ViSSee, MPS Micro Precision Systems AG). Its terms of reference and operations are not specified. Neither the new legislation (RIPA, O-RIPA, O-RIPA-EAER) nor the Federal ERI-Dispatches provide information on the work of this commission.

55 This Commission drafted the UZH Internationalization Strategy for the years 2014–2020. It is empowered to submit applications to the Executive Board of the University, particularly to advise on formulating strategic priorities and corresponding actions. The Commission is composed of representatives from the faculties. It is operationally attached to the International Relations Office of the UZH.

56 Article 16 in the chapter of the O-RIPA-EAER on 'bilateral scientific cooperation outside of international programmes and organisations' declares that 'a National Steering Committee can be responsible for bilateral programmes with priority countries or regions' (Article 16, paragraph a).

57 No information on steering committees is available on the website on the 'Federal Administration's Bilateral Programme to Promote Research Cooperation with Priority Countries' of the SERI or the website on 'The bilateral programmes of the Swiss Confederation' SNSF, or the ERI-Dispatch 2017 to 2020.

58 The 'Swiss national Steering Committees', appointed 'for most programmes', with representatives from the SER, OPET, LH, the ALH, SNSF, and sometimes the CTI (Lepori & Dunkel, 2011). The 'Joint Committees' were established for each priority country with representatives from both countries, and the SER, OPET, the LH and the SNSF representing the Swiss members (Lepori & Dunkel, 2011). While the SNSF, the SERI, and both committees were involved in the project proposal evaluation process, decision power rested with the Joint Committees. This governing structure was abandoned after 2011.

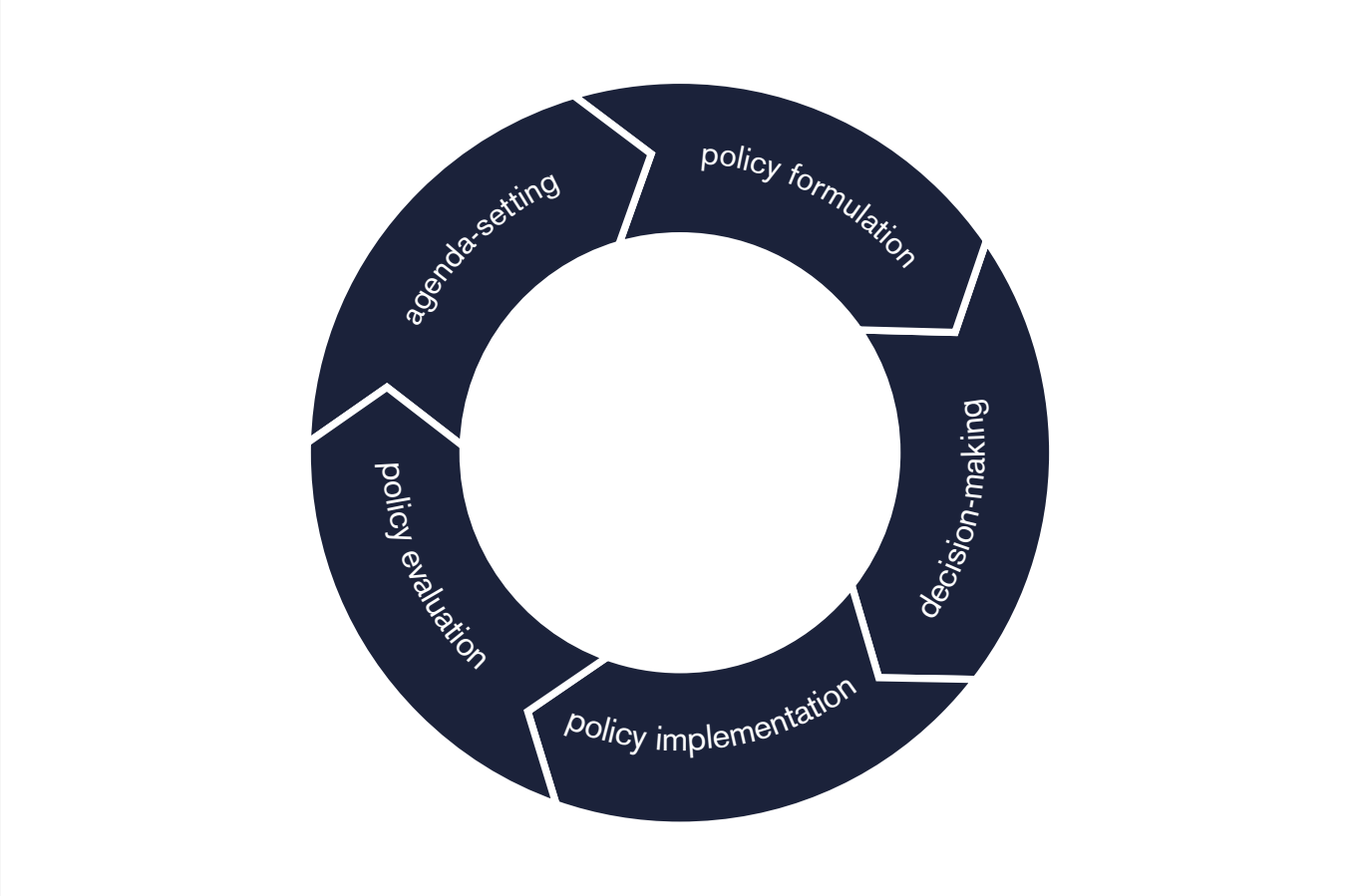

Figure 1: The five stages of the policy cycle (after Howlett & Giest, 2015)

These committees, commissions and delegations have appeared at various institutional levels in the national S&T landscape. They differ considerably with regard to their scope, purpose, responsibilities and activities. Furthermore, they appear to still be at their early stage of operation. Nevertheless, their emergence indicates an increasing demand for international S&T policy structures at the institutional level. At the same time, with the exception of swissuniversities – which only assumed operations in 2015 – these committees, commissions and delegations have not convened to develop joint communication or coordination initiatives. They also display no permanent structures or cooperation activities that connect them to federal S&T policy activities on international S&T issues[59].

During this phase of international S&T policies, Switzerland also achieved new membership in several committees of the FPs of the EU. The 'Joint Committee' to administer and implement the bilateral agreement was already established in 1986, when the Framework Agreement on scientific and technical cooperation between the Swiss Confederation and the European Commission was signed. But the full association of Switzerland in the FPs of the EU has entitled the country to dispatch representatives to various steering committees, including those responsible for future EU framework programmes. The SERI represents Switzerland in these committees.

59 The International Relations Delegation of the Swiss Rectors' Conference is the only exception.

3.7 Policy development

Policy development is a complicated matter, involving multiple actors, institutions, activities, relationships and ideas. Therefore, it is useful to reduce the complexity of public policy making by breaking it down to a series of steps. The most commonly used policy cycle model is a five-stage model, composed of agenda-setting; policy formulation; decision-making; policy implementation; and policy evaluation (Howlett & Giest, 2015) (Figure 1). This framework envisions policy development as a sequential and iterative process. The analytical framework of the policy cycle (Lasswell, 1956) will be used to map the features and mechanisms of the new international S&T policies in Switzerland since 2004.

The policy cycle allows us to differentiate the legislative content, the kinds of policy instruments, and the role of policy actors at different stages of policy development. These three elements will be considered for each stage of the policy cycle to consider the new features and mechanisms of the international S&T policies. Importantly, the iterative framework emphasises also the procedural dynamics of public policies. For example, policy evaluation is not viewed as an end in itself but often leads to the reconceptualisation of policy problems and solutions and to the modifications of positions of policy actors (Howlett et al., 2009) (Howlett & Giest, 2015:17).

Agenda-setting

The new legal framework includes no instructions or regulations on the agenda-setting stage of international S&T policies. On the contrary, it has removed responsibilities and procedures that had previously been specified. The RIPA aimed at simplifying planning processes and disposed of the agenda-setting stage on the contention that complex issues required flexible responses[60]. It thereby also abolished the procedures for setting long-term objectives for Swiss national S&T policy[61]. Neither has the IERIS filled this gap; the strategy does not set the agenda for the policy-formulation, decision-making, implementation and policy-evaluation stages of the new international S&T policies.

This omission has had three important consequences for the development of international S&T policies over the last years. First, it implicitly devolves agenda-setting procedures to research agencies outside of federal administration. The transfer of new competences for international S&T cooperation programmes to the SNSF is a symbolical case in point: the SNSF has to fill the agenda-setting gap in the federal policy cycle in order to exercise its statutory responsibilities. The recent establishment of an international cooperation committee and international cooperation strategies at the SNSF are indicative for such endeavours. However, agenda-setting competences for major federal research programmes go way beyond the customary mission of a research-promotion agency.

Second, the unspoken transfer of agenda-setting policy competences for international S&T to agencies outside of public administration has far-reaching consequences for the policy-making mission of other federal departments[62]. In particular, the foreign S&T policy mission of the FDFA is hampered in practice, because it has no legally binding authority for participation in these agenda-setting processes outside of federal administration. As a result, the non-specification of federal agenda-setting competences and procedures for international S&T policies in the new legislative framework creates a lopsided situation at the exclusion of important federal agencies. Bypassing the joint agenda-setting stage by delegating competences outside of public administration offers room for uncoordinated or even conflicting S&T policies. In addition, this approach may not fully capitalise upon existing federal resources and competences to position Switzerland in the competitive global S&T environment.

As a result of this gap in agenda-setting processes and provisions, various S&T institutions have over the past years started building own competences to set their agenda. A number of commissions, committees, or delegations have been convened. In fact, the IERIS had explicitly summoned the development of institutional strategies across the institutions of the Swiss S&T landscape. But to date these activities have remained disconnected and have not established formal channels of communication or exchange, joint statements or policy documents. Their impact on federal policies in the domain of S&T has been negligible.

Agenda-setting processes in the Swiss political system typically engage in consultation processes with stakeholder groups involved or affected by particular domains of public policies. Currently, important policy actors, such as the new institutional committees, but also business, civil society organisations, the individual higher education institutions, and political, economic and scientific associations, have no point of entry to become involved in the agenda-setting stage for developing international S&T policies.

Policy formulation

The new legislative framework provides no rules and regulations for formulating international S&T policies. As a result, this stage in the policy-development process is formally non-existent. In the absence of an overarching policy agenda, policies are formulated on an ad-hoc basis. The current budget applications for international S&T policy instruments and activities are not founded on the basis of guidelines, objectives or aggregated data on international S&T cooperation and science diplomacy. Instead, credit lines for international S&T cooperation and science policy activities are presented directly to Parliament in the ERI-Dispatches. The process of formulating the ERI-Dispatch is not specified in legal terms[63].

Planning procedures and decision-making on international S&T policy issues by default have come to rest with the agency in federal administration that is tasked with their implementation, the SERI. The SERI's response to these new responsibilities has been to delegate planning procedures and decision-making competences to other agencies by way of performance agreements and service-level contracts. In this way, policy formulation is distributed across a legally sanctioned web of selective responsibilities. Furthermore, the only federal policy document on international S&T policies, the IERIS, does not formulate coherent policies that connect objectives to challenges and measures.

60 Botschaft zur Totalrevision des Forschungsgesetzes, 2011:8861.

61 This responsibility had previously been vested with the Swiss Science and Technology Council (SSTC) (the current SSC). The SSC had previously assumed the role of a statutory advisory body to the Federal Council on all matters relating to science policy, education policy and higher education policy – this had included international S&T policies.

62 In particular, the mission of the FDFA is to coordinate sectoral foreign policies, and its Sectoral Foreign Policies Division is tasked to support the Federal Council with the definition of specific foreign policy objectives, to guarantee coherent positions in specific policy areas and efficient coordination between the FDFA and the relevant specialist departments in their pursuit of Switzerland's foreign policy interests. https://www.eda.admin.ch/eda/en/home/fdfa/organisation-fdfa/directorates-divisions/directorate-political-affairs/asa.html, accessed 22.11.2017.

63 Although these Dispatches refer to the IERIS of 2010 to make a case for claiming funds, this strategy document does not offer the necessary policy guidance for sectoral or budgetary policy decisions.

This ad-hoc approach to policy formulation has two consequential disadvantages. First, the distributed and uncoordinated policy-formulation process makes it difficult for important actors to develop their own positions and international strategies and navigate the national landscape. Second, it complicates the active development of strategic initiatives that might improve Switzerland's competitive standing and therefore favours a reactive over a proactive policy style.

Furthermore, the policy-formulation stage is an important prerequisite for the following stage of decision-making. The frequent reference to the IERIS by many actors and for various purposes indicates the central role of formulated policies for all stages of the policy cycle. It is expected to deliver strategic guidance for addressing the key challenges that are identified in the agenda-setting phase.

This interconnection is a key prerequisite for successful policy implementation. For example, the Federal Council's decision to expand the traditional range of S&T cooperation and science diplomacy to non-European countries – particularly emerging or developing economies – changed the standard separation of scientific cooperation and development cooperation as had been traditionally pursued by the Swiss Confederation since the mid-1950s. The last decade of research promotion has shown that this dissolution of boundaries presents a new challenge to research practices, research evaluation and coordination, legal agreements and funding decisions. Indeed, developing innovative alternatives for these new research territories is considered to be one of the key challenges determining the competitive position in the new global political economy of knowledge. As long as this challenge is not named on the policy agenda, policies cannot be formulated to address it, decisions have to be made without considering broader and long-term goals, and no evaluations will be undertaken to assess the effectiveness of current policies to address this challenge. For this reason, it is important to spell out challenges for international S&T policies in the agenda-setting phase, and to formulate corresponding policies to address them. Notably, the effectiveness of public policies has been shown to depend on the manner of inclusion of key actors in the policy-formulation process.

Decision-making

The new legislative framework specifies responsibilities for decision-making competences on international S&T policies. Decision-making competences are first delegated from the Federal Council to the SERI via the EAER in the RIPA and its Ordinances, and second from the SERI to research agencies and other research bodies through performance and service-level agreements. The SNSF, the Swiss Academies, and the CTI have been explicitly assigned policy-making responsibilities.

However, no regulations are issued on the decision-making processes; these are referred to as matters to be settled in service-level and performance agreements. Since these agreements are not publicly available, the decision-making instruments and process for international S&T policies are not accessible to stakeholders outside public administration. For example, the strategic rationale for current decisions on financial expenditure for the various items for international S&T cooperation and science diplomacy is not visible. The new patterns of delegation have resulted in a complex web of federal expenditure and reporting requirements. For example, the effective costs for the bilateral programmes and the Leading Houses are distributed across various budget items and are not reported on comprehensively in the ERI-Dispatch.

As a result of this situation, important stakeholder groups are restrained from participating and strategically positioning themselves in the policy development process. For example, the new International Relations Delegation of the Rectors' Conference of Swiss Higher Education Institutions (swissuniversities) is commissioned to represent the interests of the Swiss higher education institutions and to address issues that are relevant to the entire national higher education sector. This mission requires an overview of federal decision-making agencies and processes for international S&T policies. Likewise, the Leading Houses for the bilateral programmes cannot develop longer-term planning and strategies for establishing S&T cooperation traditions without the opportunity of feeding their experiences back into the decision-making process policy cycle.

Policy implementation

One of the principle objectives of the new legal framework was to settle institutional responsibilities for the implementation stage of international S&T policies. In particular, the SERI, the SNSF, the Swiss Academies, and the CTI have been allocated explicit responsibilities to implement international S&T policies. But again, implementation procedures are not specified but left to the performance and service-level agreements between the SERI and various agencies. Since most of these agreements are not publicly available, the policy implementation process is not accessible to the wider policy and research communities.

As a result, the processes leading to decisions on policy implementation cannot be traced or engaged in. This is particularly problematic for new international S&T policy activities. For example, recent legal revisions of the Ordinance to the RIPA have expanded the scope of institutions that may be bound and financed by such agreements and contracts with the SERI. Importantly, this scope surpasses that of the traditional research agencies and paves the legal path for new kinds of partnerships and organisations with business and industry. However, new institutions, such as the ILO-Office, may be located at critical boundaries that reveal some of the challenges of globalisation to national public policies; they potentially compound federal governments' roles and interests with global industries and business. If the processes and decisions that lead to such path-breaking federal decisions for implementing international S&T policies are not communicated transparently, stakeholders have few access points to engage in policy development.

The omission of the federal agenda-setting and policy-formulation stages of policy development, coupled with the lack of transparency, makes it difficult to understand how international S&T policies are implemented in Switzerland. Researchers encounter problems because their active participation in the implementation stage is held up. For example, the implementation by the SNSF of its responsibilities for the bilateral research programmes is not settled in the performance agreement between these two institutions, but in an additional protocol. This protocol is not publicly available. Knowledge of this distribution of responsibilities, however, is essential for the performers of the bilateral research programmes, the Leading Houses and the Swiss research community. Information on policy implementation is a key prerequisite for mobilising and sourcing the potential of the national S&T research community. Otherwise, important institutions such as the Swiss Higher Education Institutions and the ETH-Domain, have no possibility to keep up with the changes in the federal implementation of international S&T policies. This hampers their ability to strategically navigate the transforming S&T landscape.

Furthermore, the new legal framework does not distribute responsibilities and procedures among the federal agencies involved in implementing the new international S&T policies. This creates confusion for the implementation of the foreign S&T policy mission of the FDFA. For example, the policy implementation measures of the SDC have to formally abide by the mission and organisational principles of the FDFA. At the same time, they are informally expected to support the IERIS. International S&T agreements have been signed by the SERI with countries that had previously been bound to S&T agreements on development cooperation. The exploratory missions to emerging and developing countries, too, cross the missions of both the SERI and the FDFA. Furthermore, ambassador status has been assigned to leading staff at the SERI; but they are tied by employment conditions and organisational ordinances of the EAER although the FDFA in principle is responsible for the Swiss foreign network. This situation may indicate inter-departmental cooperation but also leaves plenty of room for potential overlap or even contradicting policy decisions.

Policy evaluation

The new legislative framework has issued clear instructions to the Federal Council on some overarching issues relevant to the evaluation stage of international S&T policies. The RIPA orders the Federal Council to take appropriate measures to review and coordinate national and international promotion policies[64]. Furthermore, the RIPA imposes the duty on the Federal Council to achieve coherence between international cooperation on research and innovation and Switzerland's economic foreign policy, development policy and general foreign policy[65]. The instruments and procedures required to fulfil this duty, however, are not stipulated in the new legal regulations. Neither does the new legal framework provide instructions for evaluating the instruments for international S&T policies. For this reason, the new international S&T policies instruments of the past decade have not been evaluated regularly, neither have they been subjected to public reporting requirements. Evaluations were commissioned on an ad-hoc basis and not as preparations for revising the various stages of the policy cycle.

Policy evaluation is an important stage of policy development because it provides the basis for reviewing existing policies, objectives, strategies, and instruments. In addition, evaluations assist to manoeuvre policy decisions in complex environments and to identify the problems that need to be taken up by the policy agenda.

To conclude, the current legislative framework specifies certain responsibilities for the decision-making and implementation stages for developing international S&T policies but it leaves open procedural issues and public reporting requirements. For example, public agencies are vested with the competence to sign international agreements of limited scope, but they are not subjected to publishing requirements or regular reviews based on policy objectives.

At the same time, the new legislative framework does not attend to several stages of the policy development process. It distributes no responsibilities and defines no procedures for the agenda-setting, policy-formulation and policy-evaluation stages. This corresponds to the overall policy approach that has been followed over the last phase of international S&T policies, which adheres to a bottom-up policy approach. This approach emphasises the decision-making and implementation phases of policy development and casts the policy process as a matter of distributing funds and the role of public administration as subsidiary coordination. The bottom-up approach relies on the assumption that agenda-setting, policy-formulation and policy-evaluation stages are naturally covered by the involvement of researchers. In fact, however, the absence of these stages in the development of international S&T policies has effectively shifted the responsibility either to intermediary institutions such as the SNSF, or by default to the SERI.

At the moment, key decisions that will impact the future strategic positioning of Switzerland in an environment of increased competition, are made without an overarching vision or framework, and without conscious policy-making processes that cover the entire policy cycle of agenda-setting, policy formulation, decision-making, implementation and evaluation. A brief look across the national borders demonstrates that other countries have moved faster to institute procedures and responsibilities for the stages in international S&T policy development. Germany, for example, has developed individual international S&T policies and action plans for specific geographic regions or countries (such as, for example, China or Africa), and for institutional challenges (such as, for example, the new challenges for higher education institutions), committees to regularly revise these strategies, and new agencies and tools to aggregate and distribute information to the research community. In contrast, the Swiss bilateral research programmes for China are administered and carried out by research agencies, without federal policy guidance or action plans, and without committees to guide and oversee their implementation.

The analysis based on the framework of the five-stage policy model points to the need to establish regulations and procedures for the agenda-setting, policy-development and evaluation stages to complement the current focus on delegating legal responsibilities for the decision-making and implementation stages of the policy development process. This would require information on the current policy procedures of the decision-making and implementation stages, such as statistics on expenditure. Information is considered an essential component to secure the iterative dynamics of the policy cycle, the involvement of key players outside public administration, and the effective implementation of policy measures.

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64 In principle, the new RIPA adhered to the principle of self-coordination that had already guided the Research Act of 1983. But the importance of aligning national and international R&I promotion had risen in the face of growing international competition. The Federal Council's mandate to take additional coordination measures therefore only applied in face of an actual need to complement gaps that arise in the self-coordination of these institutions. This need was identified for the international research promotion of the Swiss Confederation. Botschaft zur Totalrevision des Forschungsgesetzes, 2011:8860.

65 RIPA, Article 41, paragraph 3b.

Profile of current international S&T policies in Switzerland

4

Profile of current international S&T policies in Switzerland

Global transformations in S&T have impacted on national S&T policies over the past decade. They have challenged the jurisdictional and organisational boundaries and sovereignty of nation states. The 'accelerating flow of ideas, information, goods and money across national borders' (Perl, 2015:44), has affected the traditional rules and norms, the governing actions and responsibilities for matters relating to S&T.

The new features and mechanisms in the international S&T policies of Switzerland as a whole characterise the Swiss S&T policy response to these global influences. However, the dependence of Swiss national S&T policy on international developments is not a new occurrence. In fact, Swiss national S&T policy was fashioned in full awareness that the country's national competitiveness depended on its successful integration in European S&T cooperation and science diplomacy (Benninghoff & Leresche, 2003; Joye-Cagnard, 2010).

For most of its history, Swiss S&T policy has been concerned with finding ways to integrate its national S&T community into the evolving European S&T policy landscape. But over the past decade, international S&T policies in Switzerland have attempted to accommodate an additional, new dependency: national competitiveness no longer depends only on successful integration in European S&T but on S&T cooperation and science diplomacy with a set of emerging and developing countries. This new awareness has motivated the new Swiss initiatives in S&T cooperation and science diplomacy since 2004.

The following chapter will attempt to sketch a profile of the current international S&T policies of Switzerland, based on the examination of its new features and mechanisms in the previous chapter. A list of strategic issues and key questions are then derived from this profile in chapter 5.

4.1 Switzerland's S&T policy response to globalisation

The Swiss S&T policy response to the new global environment over the past decade has been simultaneously centralised and dispersed. On the whole, most of the new international S&T policies features and mechanisms were governed and managed in a centralised manner, with the exception of their early days. The processes leading to the first Swiss strategy for international ERI in 2010, the total legislative revision of 2012, and the new instruments for international cooperation and science diplomacy were all shaped and administered by lines of decision-making that converge at a single federal agency of public administration.

At the same time, however, Swiss S&T institutions of all kinds have had to navigate the changing national policy environment and new conditions in their day-to-day business, and have developed hands-on responses to global pressures at the institutional level (Chapter 3.4). The advent of several institutional advisory committees and international strategies indicate efforts to manage and coordinate these challenges (Chapter 3.5). However, no new platforms, networks, cross-institutional channels or organisations have emerged to connect or coordinate these institutional activities, except for the recently established International Relations Delegation of swissuniversities.

Neither have measures been taken at federal level to coordinate or promote the individual institutional responses. The legal framework for such coordination, however, is provided in the RIPA, which designates this responsibility, along with the related reporting requirements, to the Federal Council. For such coordination is required for federal government to be able to identify and carry out its subsidiary role in the national S&T landscape. Without this coordination, the task of formulating federal policies to support the institutional responses to global influences becomes unfeasible.

Why has Switzerland chosen to follow this particular path, simultaneously centralised and dispersed? Literature suggests a typical two-phased response of policymakers to new influences that challenge the borders of formal state structures and the roles and routines of their S&T policy subsystems. The first reaction is 'to turn inward toward the policy community participants they know best and seek a modest revision of the recipes that are most familiar to them' (Perl, 2015:50). This reaction evidently applies to the latest phase of international S&T policies in Switzerland. For example, the bilateral programmes were launched under a new model of international S&T cooperation under the policy auspices of Leading Houses at Swiss universities, were assimilated into the existing national system of S&T promotion and modified to fit into the standard portfolio of the Swiss National Science Foundation.

First-level reactions, however, are typically succeeded by second-level responses to global pressures, which 'would see the state changing its relationship with actors in the policy community' (Perl, 2015:50). This change in relationship can proceed in two possible directions. One possibility is to shift the 'delegation of authority from one set of actors to another' (Perl, 2015:50). This course was followed for international S&T policies of Switzerland over the past decade. The new legislative framework (composed of the triad of the RIPA, the RIPA-Ordinance, and the Organisational EAER-Ordinance to the RIPA-Ordinance), impressively illustrates this strategic manoeuvring of authority. The first delegation of authority passes from the Federal Council to the SERI, via the EAER. Once arrived at the SERI, authority is selectively delegated to a variety of different kinds of institutions, by way of a multitude of service-level and performance agreements with the SERI.

Importantly, however, the delegation of authority does not remove power dynamics from the second-level response: Authority 'may well be delegated and shared across the policy community, but in one form or another, power influences the outcome of policy-making' (Perl, 2015:48). Furthermore, since policy outcomes will be shaped 'by who has the power to make decisions binding across all of society based on the sovereign authority of government' (Perl, 2015:48) this type of relationship and associated 'terms of engagement can enable a particular policy community to dominate all stages of the policy cycle, from agenda-setting through policy evaluation' (Perl, 2015:50).

The second possible direction of the second-level response to global influences would be to admit new actors 'into the corridors of power' across the various stages of policy development. This admission would expand 'the range of outcomes that could be considered acceptable' (Perl, 2015:50). This manner of second-level response includes a grand challenge; it requires developing tactics to adjust to a new policy paradigm.

4.2 From the European Union to the World: An expansion of historical significance

The last phase of international S&T policies covers the entire period of Switzerland's full association with the FPs of the European Union; a successful outcome of more than two decades of science diplomacy. This international S&T policy achievement was temporarily put at peril due to the fact that it was part of a package of political agreements with the EU. The two-year episode of instability demonstrated that decades of international S&T policy efforts have not been able to eliminate their vulnerability to perturbations in thematically unconnected areas of foreign policy. But in quantitative terms, the EU remains the most important partner for Swiss international S&T cooperation. For these reasons, Switzerland's international S&T policies since 2004 have continued to focus their efforts in the first instance on S&T cooperation and science diplomacy with this geographical region.

Nevertheless, from a policy perspective, this strategic focus of the international S&T policies of Switzerland on its traditional research partners in Europe does not inevitably accord with the main strategic policy challenges of the past decade. R&D statistics might point to Europe as main S&T cooperation partner of Switzerland, but the policy tools and instruments for these partnerships have benefitted from decades of policy attention and gradual growth of policy structures. If, however, qualitative indicators of change are considered, the new international S&T policies for S&T cooperation and science diplomacy with non-European countries draw policy attention.

From the mid-1950s up until the beginning of the new millennium, international S&T cooperation in Switzerland, in general, tacitly implied cooperation with Europe. During these decades, Switzerland developed its specific S&T policy profile composed of a unique set of national policy structures, instruments, institutions and processes. These matured in political processes, amidst different national political, scientific and social interests, but also under the continuous pressure to secure participation in European S&T projects, programmes and initiatives. Apart from a few exceptions, the strategic orientation of international S&T cooperation and science policy of the last century was directed at a specific geographical region: Europe.

But during those years Switzerland also entertained a second, parallel S&T policy strategy on the international stage, although it was not designated as international S&T policy at the time. Policies for S&T cooperation with particular global regions and countries beyond Europe were devised under the banner of 'development cooperation'. These policies developed parallel S&T policy structures, instruments, institutions and processes under the auspices of the FDFA. This lineage of research promotion has endured to this day and finds its current expression in the SDC's research portfolio.

Since 2004, the boundaries between these two lineages have been crossed at the research-programme level. For example, the bilateral research programmes under the auspices of the SERI promoted research projects with countries in which the SDC was already active. The joint r4d Programme of the SDC and the SNSF provides a further example for the ongoing blurring of the boundaries between development cooperation and scientific research. However, these kinds of shifts that have been taking place over the past decade were not accompanied by international S&T policy structures and guidelines. For example, matters concerning the devolution of responsibilities between the SERI and the SDC, are still bound to an outdated agreement dated 5 December 2002, entered into by the Directorate of Corporate Management of the FDFA and Group for Science and Education, one of the predecessor organisations of the SERI. Yet this agreement has recently been named as one of the leadership instruments to steer the Swissnex Network by the Swiss Federal Audit Office (SFAO, 2016:28). One of the reasons why this distribution of competences and powers is not a simple matter has to do with its connection with one of the guiding policy principles of Swiss national S&T policy: that S&T interaction across national boundaries takes place either for the benefit of development cooperation or for the sake of scientific cooperation.

The non-formalised current distribution of competences between the FDFA and the SERI, however, represents a major building block for shaping Switzerland's international S&T policies with emerging and developing countries in the future. For, the ability to build new traditions of S&T cooperation with emerging and developing countries is widely considered as the key to the future position of nation states in the future global political economy of knowledge.

4.3
Policy communities and networks

Important aspects to consider when assessing the new international S&T policies since 2004 are the policy communities and networks. The term 'policy community' designates the set of public and private actors that coalesce around an issue area and share a common interest in shaping its development (Coleman & Skogstad, 1990). The related term 'policy network' labels the structural or power relationship between the actors of this policy community (Coleman & Skogstad, 1990). It is expressed in the degree and means of interaction, coordination and governance among the policy community.

Public policies depend upon the character and constitution of the policy community and its network (Howlett & Giest, 2015). The structure and performance of policy networks are an important indicator for the level of integration among these communities (Howlett & Giest, 2015:19). The level of integration among policy communities, in turn, influences the effectiveness of public policy.

For this reason, the disposition of Switzerland's international S&T policy community and network is relevant with regard to its capacity to respond to global challenges. For, while policy communities may have 'appeared fully functional within a particular policy paradigm [they] will quickly degenerate into confusion and conflict under the influence of transnational ideas and information' (Perl, 2015:51). The expansion of S&T cooperation to emerging and developing countries involves new local and foreign policy agents and therefore holds the prospect of transforming the national policy community and its network.

Over the past decade, new initiatives have been launched in international S&T cooperation and science diplomacy, and attempts have been made to formulate policy guidelines, objectives, strategies and implementation tools. The number of agents involved in international S&T policy affairs has risen across various institutional levels of the Swiss S&T landscape (Chapter 3.4). However, there has been no empirical evidence for a corresponding strengthening of the national policy community and its network concerned with international S&T matters.

Switzerland's international S&T policies with the European Union has assembled a policy community over decades of S&T cooperation and policy activities; these have continued to be active during the last phase of international S&T policies. However, over the past decade, Switzerland has laid the foundations for its future international S&T policies with emerging and developing countries. Considered against the importance afforded to this expansion internationally, the absence of a new policy community and network in the development of these new policies is unfortunate. The failure of the new international S&T policies to build these communities does not only affect the quality of its policies, but also the quality of cooperative research projects.

The bilateral programmes, again, are a case in point: Their early governance structures and processes included various committees, levels of governance and regulations for procedures. They required time-consuming processes that included the policy communities from both countries. Their powers were scaled down to assimilate the bilateral programmes into standard research-promotion procedures at the SNSF. The accompanying committee structures have been abandoned and the responsibilities of the Leading Houses were cut back. Research in the field of development cooperation has for a long time already advocated the need for participatory and inter- and transdisciplinary approaches in this endeavour, and the importance of building traditions of cooperation.

Policy communities and networks can be strengthened by federal coordination measures and initiatives. Typically, the motivation of the federal government to take steps in this direction stems from the insight that a vibrant policy community and innovative network increase the effectiveness and prospects of policy implementation. Well-integrated policy communities are composed of stakeholders across the domains of politics, business, industry, civil society and public administration who interact in joint working arrangements across their institutional boundaries (Perl, 2015:53). The authorities involved in shaping international S&T policies under such conditions are much more likely to be distributed (Perl, 2015:53).

Usually, national policy documents provide a unique tool to engage in processes that build policy communities around issues of national importance. However, the empirical analysis of the new features and mechanisms that have emerged in international S&T policies of Switzerland exposed frail connections between its most important federal policy document and its national policy community. The vision, objectives and priorities of the current international S&T policy document do not speak to the policy communities that are to bear the consequences of its implementation.

4.4
Distribution of policy-making responsibility

The distribution of policy-making power across the various stages of the policy cycle (agenda-setting, policy formulation, decision-making, policy implementation, policy evaluation) is an important consideration for S&T policy. With regard to international S&T policies, two issues need to be considered. First, S&T policy is traditionally conceived of as resulting from the execution of powers between the state and civil society. One of the key challenges in responding to global forces is the intrusion of new transnational or international power structures into the traditional authority of the nation state. As already indicated at the outset of this chapter, public-policy responses to these new influences can follow various typical paths. The choice of a particular path also largely determines the distribution of policy-making powers.

Second, the degree of integration of policy communities and networks provides indications for the distribution of policy-making powers between the state and civil society actors. However, the national boundaries of this classic conception are broken down by global S&T interactions and transnational S&T practices. International S&T policies involve an increasing number of diverse actors, including international agencies, foreign government agencies, cross-national industrial corporations, business enterprises, and others. These do not simply multiply the number of agencies involved but rather, they add new layers of relations (Rosenau, 1995).

As outlined above, the Swiss response to global S&T transformations assimilated the new S&T initiatives with emerging and developing countries into existing S&T policy structures. This section will illustrate the effects of this particular response on the distribution of policy-making power on international S&T issues. The short history of Switzerland's new policy instruments in Chapter 2.4 demonstrates this particular distribution.

In 2010, an 'International ERI Strategy of Switzerland' was endorsed by the Federal Council. This federal S&T policy document was formulated by public administration without stakeholder input in its agenda-setting and policy-formulation stages. The document offers no guidance on measures and financial investments. Instead, it simply returns and endorses the authority of the regular federal ERI-Dispatches to determine these issues. In this way, the first International ERI Strategy was downscaled to a mere complement to existing national S&T policies as presented in the regular ERI dispatches to parliament. The ERI-Dispatches, in turn, referred to the IERIS to legitimate policy decisions and financial contributions. This hollow criss-cross delegation of S&T policy authority ultimately serves to obscure the sites and agents of decisions and policy-making powers on specific issues.

The complete revision of the legislative framework for S&T, too, has contributed to centralised decision-making for shaping international S&T policies. The new Research Act of 2012 prima facie delegated tasks to various research-promotion agencies (SNSF, Swiss Academies, CTI). But de facto the entire package of legislative changes included a set of related ordinances that centred all stages of the policy cycle at a single departmental agency. The new legislative framework empowered this agency to be in charge of the entire policy cycle, including agenda-setting, policy formulation, implementation and evaluation.

At the same time, the new legislative framework downscaled the influence of the agency previously assigned with the task to advise the Federal Council on national and international S&T issues to the federal government, the Swiss Science & Technology Council (the SSTC, today the SSC). The scaling back of its responsibilities removed this agency's influence to contribute to all stages of the policy cycle. This responsibility was thereafter, by default, conferred to a single agency in public administration.

The new legislation also conferred to the SERI the authority to conclude international treaties of limited scope, without stipulating general binding conditions for consultation with other federal agencies or stakeholder groups. For example, the new legislation does not require the SERI to consult the FDFA. Likewise, the SERI is fully in charge of the scope, purpose and financing of exploratory missions to emerging and developing countries. Furthermore, since the Swissnex network has no legal mention, the SERI, again by default, assumes policy responsibility: it determines the Swissnex locations; determines the tasks, responsibilities and reporting requirements for the individual Swissnex Houses; and appoints the members and terms of references of its Steering Committee. Finally, the new legislative framework also assigns to the SERI the authority to appoint Steering Committees to the bilateral research programmes with priority countries or regions (Art. 51, paragraph 1, O-RIPA).

The new legislative framework, however, delegates competences without at the same time specifying and adapting the rules and procedures accordingly. In the absence of such authorised rules and procedures, the default authority for key stages in the policy cycle rests with the SERI. The consultation with stakeholders, advisory bodies and agencies, attains voluntary status. The integrative effect of consulting national S&T policy communities in the policy making in the field of international S&T is not capitalised upon.

Accordingly, the national policy response to the new challenges of the past few years was devised in an environment skewed towards centralised rather than distributed policy making at a single agency in public administration, without an independent agency to oversee its performance, and without the engagement of national S&T policy communities.

This choice of national policy response to global S&T transformations stands in contrast to the responses of the EU and other European countries. The European Union in 2008 recognised that the new global shifts in S&T required long-term policy and strategic attention. It has since developed coordinating structures and processes to support policy-formulation, implementation and evaluation activities for its international S&T policies. Germany has followed a similar path, and presently has at its disposal a range of policy resources, such as regional-specific international strategies, joint policy documents between the federal government and the *Länder*, action plans, monitoring and information services for researchers and promotion agencies. Its federal government has constituted advisory committees, and initiated policy-development processes at various institutional levels to build and strengthen its national policy community.

The low degree of integration of the Swiss policy community and network in decisions on international S&T matters has impacted on the outcomes of important policy procedures and results. The resulting distribution of 'public power' between state and civil society actors in favour of federal government has served its particular response to global perturbations: the assimilation of new initiatives into existing policy structures and processes. Ultimately, however, the growth of vibrating policy communities in international S&T policies after a decade of policy initiatives, is impeded by an outdated policy paradigm that continues to shape the approach of public administration to the new challenges of globalisation in Switzerland, as will be discussed below.

4.5
Transforming policy paradigms and principles

As noted above, Switzerland's response to the transforming global political economy of knowledge over the last decade was guided by its particular national S&T policy paradigm (Hall, 1993), or policy regime (Wilson, 2000; Elzinga, 2012). The term policy paradigm designates the guiding principles for selecting and addressing critical problems (Hall, 1993). These principles evoke images or metaphors that assist policy agents to decipher complicated circumstances. Importantly, their guiding ideas and beliefs confer legitimacy to certain actors in the policy community and not to others (Perl, 2015:49).

In the case of Switzerland, the reigning national S&T policy paradigm was shaped over the course of decades during the last century. On the international front, its objective was to successfully steer Switzerland's enduring attempts to participate in the ever-progressing European research projects and programmes. The empirical analysis of the last phase of international S&T policies in Switzerland indicates that four central policy principles or codes of the traditional S&T policy paradigm no longer apply. These policy principles adhere to the following ideas:

a) There is no top-down, centralised S&T policy making; instead, national S&T policy is steered in a bottom-up process;

b) National and international S&T policies are intrinsically complementary;

c) Federal S&T promotion measures do not include direct financial contributions to the private sector;

d) S&T interaction across national boundaries takes place either for the benefit of development cooperation or for the sake of scientific cooperation.

The following examples will illustrate that these policy principles do not correspond with the international S&T policy practices of the new millennium.

a) There is no top-down, centralised S&T policy making; instead, national S&T policy is steered in a bottom-up process.

The term 'bottom-up' is frequently used in federal S&T policy documents to characterise its system of research and innovation promotion (SERI, 2016:13; 54)[66]. This national 'bottom-up' system is presented as complementary to the 'top-down' funding schemes of the European Union[67] (SERI, 2016:8).

However, Switzerland contributes considerable funds to the EU funding schemes. Even if these funds find their way back to Switzerland through EU grants, they remain a federal item of expenditure for S&T. The Dispatch on the Financing of Swiss Participation in the FPs of the EU for the years 2014 to 2020 applied for a total amount of 4389.3 million Swiss francs. Considered from this angle, the Swiss contributions to the EU programmes amount to a significant proportion of total national expenditure on S&T. Therefore, the bottom-up image of Swiss research promotion would need to be replaced by an image that combines bottom-up *and* top-down procedures.

Furthermore, other items of expenditure for international S&T may not easily fit into the current image of a 'bottom-up' system of promotion. Examples for such items of expenditure are participation in international organisations (for example, CERN) or participation in international research programmes (for example, ESA). Although no statistics are available on the proportion of total national expenditure for S&T that flows into international S&T cooperation, the dimension of these contributions may be considered significant. Just a quick look at the items of expenditure involved in international S&T cooperation in Switzerland, therefore, confirms that these activities are not inevitably governed in 'bottom-up' processes in Switzerland.

If the flow of federal funds for international S&T cooperation were included into an overall conception of how S&T promotion works in Switzerland, a different picture would emerge in which S&T promotion in Switzerland is composed of both top-down and bottom-up processes.

'Top-down' research-promotion systems and their 'bottom-up' counterparts involve different kinds of policy-formulation, implementation and evaluation processes. The Swiss insistence on a 'bottom-up' approach therefore, at the same time selects a corresponding policy approach. The bottom-up metaphor with one stroke renounces the need to include 'the bottom' into the policy cycle – for, it assumes that its representatives are already involved and, in actual fact, ultimately govern this S&T policy approach. If this image were to be changed to a combination of top-down and bottom-up, the need to coordinate and reconcile the respective policy procedures would become apparent.

In combination with centralised policy making for international S&T policies described above, these considerations suspend the first principle of the current policy paradigm; Swiss S&T policy is steered centrally, and involves both top-down and bottom-up policy processes.

b) National and international S&T policies are intrinsically complementary.

From the above-mentioned first principle it follows that the Swiss federal approach to developing new international S&T instruments has been guided by the assumption that national and international S&T policies are intrinsically complementary. This assumption holds that they do not inherently contradict each another and therefore require no mutual adjustments or compromises.

However, the examination of the new features and mechanisms of international S&T policies since 2004 has shown that this assumption is inappropriate. An international strategy for ERI, by mere virtue of its extra-national orientation, does not automatically assure its complementarity to national S&T policy strategies. This assumption was refuted in the analysis of the alleged complementarity of the IERIS and the ERI-Dispatches. Neither can the assimilation of the bilateral programmes into the standard SNSF promotion tradition guarantee that it will successfully implement the international S&T policies for non-European countries and automatically complement the research portfolio of the SDC. Likewise, joint enterprises between traditional funding agencies for science, and funding agencies for development and cooperation, such as the r4d Programme, do not inevitably produce research results that simultaneously satisfy scientific and development objectives.

The challenge of having to reconcile national with international S&T policy interests, objectives, structures, institutions, legal frameworks, and national research-promotion structures, however, is not singular to Switzerland but characterises one of the key challenges of globalisation (Soete et al., 2015:53). Ignoring its existence by simply insisting on the complementarity of national and international S&T policies, however, is unlikely to provide an ideal starting point for developing sustainable solutions to this challenge in an increasingly competitive and transforming global knowledge economy.

66 SERI (2016): 'Forschung und Innovation in der Schweiz'.

67 SERI (2016): 'Swiss National ERA Roadmap', recently submitted to the European Research and Innovation Area Committee (ERAC).

c) Federal S&T promotion measures do not include direct financial contributions to the private sector.

The new legislative framework permits the allocation of federal funds and support to a new category of institutions: 'non-commercial research centres outside the higher education sector' (RIPA, Article 4). These are defined as 'institutions with public or private funding bodies, whose aim is to conduct research activities'. Although a number of specifications are included, this RIPA article leaves room for broad interpretation. In this way, it opens a window for subsequent further provisions in the O-RIPA and the O-RIPA-EAER. Importantly, the insertion of further provisions at the level of ordinances can be passed under less consultation and controlling procedures – though these, too, are not uniformly determined but leave open various possibilities in procedure.

For example, the O-RIPA has recently been extended (per 1 December 2017) to allow for the SERI to single-handedly decide on financial contributions to 'non-commercial institutions and organisations for information and consulting activities'. The recent joint launching of the ILO-Office by the SERI, the EPLF and the PSI exemplifies the flow of subsidiary federal funds to such a 'non-commercial research centre outside the higher education sector'. Since all three parties are funded by federal funds, the institutional structures and personnel costs of the ILO-Office are financed with federal funds, too. The ILO-Office provides services and support to business and industry that, in other areas of economic activity, need to be provided by associations of private sector institutions themselves. In effect, therefore, the ILO-Office exemplifies the flow of direct federal subsidies to private sector organisations. But despite its significance and potential complications, this amendment was effected without prior public consultation and debate. Its strategic placement in the ordinance to the RIPA rather than the RIPA itself, precludes the need to undertake wider consultation.

These new legal provisions have potentially wide-ranging consequences for the newly emerging international S&T policies of Switzerland. The triad of legislative regulations of the RIPA, the O-RIPA and the O-RIPA-EAER opens the gates for further possibilities of subsidising business and industry – albeit without any specific provisions to regulate situations where these companies operate in an intricate web of global operations.

They confer a wide range of responsibilities to the SERI for shaping international S&T policy without specifying the policy procedures and guidelines necessary to control them. At the same time, however, the SERI continues to propagate this principle of providing no direct financial support for private R&D.

The recent legislative amendments have implications for the current Swiss S&T policy paradigm which propagates the Swiss principle of subsidiarity and disapproves of direct federal financing of private-sector research. This policy principle is no longer guaranteed by the legislative framework for international S&T policy.

d) S&T interaction across national boundaries takes place either for the benefit of development cooperation or for the sake of scientific cooperation.

For most of their history, Swiss S&T policies have been formulated and implemented for two broad geographic regions; 'Europe', and 'emerging' or 'developing countries'. The former was classified under the category 'international' and the latter under the category 'development and cooperation'. These categories required different kinds of research objectives, methods, procedures and expected results and outputs. This division of labour acted as an overarching guiding principle to determine and address critical problems (Hall, 1993) in these distinct domains. It was also imprinted in the international S&T policy lineages of the EAER and the FDFA, and the SERI and the SDC respectively. The corresponding separation in public administration of policy measures and instruments continues to this day.

This separation has been challenged during the last phase of international S&T policies. The new instruments for international S&T cooperation moved the scope of the SERI's international S&T promotion activities into geographical areas in which the SDC was already active. At the policy level, too, the traditional separation of responsibilities for international research promotion has been disturbed. For example, the first International ERI Strategy of 2010 declares in a footnote that, 'in the past, aspects of Switzerland's international science strategy were included in the FDFA's foreign policy'. There is no evidence for policy procedures that led to the decision to transfer this policy-making power from the FDFA to the SERI.

At bottom, however, the shift illustrates a blurring of the boundary between the traditional categories of 'scientific cooperation' and 'development cooperation'. This division had functioned as guiding principle to 'evoke images or metaphors that assist policy agents to decipher complicated circumstances' (Perl, 2015:49). Their 'guiding ideas and beliefs' have in the past conferred 'legitimacy to certain actors in the policy community and not to others' (Perl, 2015:49).

Dissolving the boundaries between 'scientific cooperation' and 'development cooperation', therefore, disassembles the images or metaphors that assist policy agents to decipher complicated circumstances (Perl, 2015:49). They also disturb the traditional patterns of distribution of 'legitimacy to certain actors in the policy community and not to others' (Perl, 2015:49) because they disrupt their 'guiding ideas and beliefs'.

However, joining forces by running joint research programmes that aim to combine the objectives of the two categories 'scientific cooperation' and 'development cooperation', is unlikely to offer new guiding principles for navigating this situation. The challenges require orchestration and efforts that address the consequences for S&T policy of the dissolution of boundaries between these categories.

The problem, once more, is generic to the current reshuffling of national S&T systems to respond to the changing global political economy of knowledge. The demise of this policy principle presents a policy challenge to many European countries and the European Union. However, as long as this demise remains unacknowledged in Swiss federal S&T policies, the necessary steps cannot be taken to start addressing it.

Four strategic issues and an associated set of key questions are presented in the next chapter. They are derived from the discussion of the new phase of international S&T policies of Switzerland between 2004 and 2017. The discussion, in turn, is based on the analysis of the new features and mechanisms of international S&T policies in Switzerland during this recent phase, against the background of its historical development.

Strategic issues and key questions

5

Strategic issues and key questions

5.1
Strategic issue: expenditure

Federal government issues no annual statistics on Swiss expenditure for international S&T and science diplomacy, neither does the ERI-Dispatch provide a comprehensive overview of these items of expenditure. But information on national expenditure in this policy domain is essential for policy decisions in an area of public policy that is considered of increasing importance in securing Switzerland's competitive standing in the changing international economy of knowledge.

A strategic policy issue because ...

- Financial information is an indispensable tool for policy formulation and decision-making. Current decisions on international S&T policy issues in Switzerland are made in the absence of basic information on current federal expenditure.

- Federal government is required by law to check, 'periodically or when required, the coordination between national and international promotion of research and innovation' (RIPA, 2012: Art. 41). This task cannot be carried out adequately without information on financial expenditure.

Key questions:

- How much money is Switzerland currently spending on international cooperation in research & innovation and science diplomacy? In which categories of expenditure?

- Which processes and committees guide investment decisions?

5.2
Strategic issue: policy design

International S&T policies are key instruments to secure global competitiveness in S&T. They form an essential part of the policy framework that determines the sustainability of national research systems. Over the past decade, new international S&T policies have emerged in response to the changing global political economy of S&T. Switzerland, too, has developed a new set of international policy initiatives for S&T cooperation and diplomacy.

The complete revision of the Research Act has specified new rules and regulations for policy design. These have focused on assigning responsibilities for the decision-making and implementation phases of the policy cycle, and have not covered procedural issues. Furthermore, the new legislative framework has not stipulated procedural or structural requirements for the agenda-setting, policy-formulation and policy-evaluation stages of the policy cycle. This has impeded the development of an iterative policy-making process for international S&T

policies that capitalises upon the diversity of experiences of its policy community. As a result, important policy tools, such as the International ERI Strategy, international S&T agreements, new S&T research programmes with emerging and developing countries, and exploratory S&T missions are not integrated in the policy-shaping dynamics of the policy cycle.

A strategic issue because ...

- Core elements of the policy cycle on international S&T policies (agenda setting; policy formulation; decision-making; policy implementation; policy evaluation) are not regulated and by default are entrusted to public administration. Policy procedures and responsibilities across these stages are not accessible and the separation of governance and executive powers cannot be verified by independent agencies.

- Federal government is legally obliged to coordinate the national and international promotion of R&I (RIPA). By consequence, its national and international S&T policies have to be designed in mutual coordination.

- New international S&T policies stand to benefit from a policy design that addresses the entire policy cycle. This perspective facilitates the attempt to correlate policy challenges and objectives with decisions and tools for implementation. It also serves to prioritise the key elements that have to be in place for correlation to take place, such as the joint formulation of a national policy document containing a vision, challenges, objectives, and measures that address current circumstances, or the collection of information on actual expenditure.

Key questions:

- Who is involved in the different stages of the policy cycle for international S&T policies? Which instruments are employed for the agenda-setting, policy-formulation, decision-making, policy-implementation, policy-evaluation stages?

- What policy processes and committees are required in the future to secure quick and strategic responses to a global environment of shifting challenges and opportunities?

5.3
Strategic issue: complexity

A complex international environment with new patterns of competition and research practices increasingly challenges national S&T systems. Their ability to develop innovative international S&T policies to respond to these changing conditions is likely to have a long-term impact on their competitive global standing.

Public policy development is a complex matter and globalisation has added new layers of complexity by challenging areas of national sovereignty at a rapid pace. Over the past decade Switzerland has responded to these challenges with a reactive approach in line with the bottom-up paradigm that has guided its national S&T policies. The resulting new S&T policies of the past decade show that this approach to complexity has not been sufficient to develop an effective policy cycle; the new challenges require active policy-making approaches. New patterns have emerged within the complexity of diverse issues, players, interests and uncertainties involved; there are indications that institutions at various levels have been developing policy measures and instruments to address this complexity. The subsidiary role of government in the research landscape was highlighted in the Swiss Constitution to actively support such complex and distributed changes at federal level.

In order to secure Switzerland's competitive position on the transforming international map of scientific excellence, it is essential to design new policy processes that directly address the increasing complexity of issues involved.

A strategic policy issue because ...

- Diverse and dynamic international environments require new policy instruments, measures and procedures at the national level.

- The international S&T policy landscape in Switzerland has grown in size and orientation. New national players and permanent committees, an amended legal framework (RIPA), and new items of expenditure have come forth. These complex changes and patterns call for a new generation of international S&T policies that ensures permanent attention and reconsideration; administrative flexibility, foresight, monitoring and access to information; action plans.

- Public administration alone cannot deliver comprehensive international S&T policies for complex settings. Effective public policy requires coordinating, incorporating and managing the interests and experiences of the entire spectrum of stakeholders.

Key questions:

- Which new policy measures, procedures and instruments are required to sustainably address the increasing complexity of international S&T cooperation and science diplomacy?
- What new procedures and agencies can the federal government institute to fulfil its statutory responsibility to coordinate national and international S&T policies?

5.4
Strategic issue: policy resources

As the field of international S&T policies grows more complex, new material and financial resources are required to support the new challenges in agenda-setting, policy formulation, decision-making, policy implementation and policy evaluation. Compared to other policy domains of national importance, there has been a shortage of information and funds for these policy elements for the past decade – and barely any debate both in public and in politics on the governance of this important policy domain.

However, information essential for these processes – such as statistics on national expenditure for international research, innovation and science diplomacy, bi-lateral agreements or participation in international organisations – is not obtainable. Furthermore, information on the distribution and delegation of responsibilities, as specified in performance agreements between the SERI and official S&T institutions, is unavailable and therefore obstructs the strategic navigation of this policy domain by stakeholders working outside of public administration.

Departmental research (*Ressortforschung*) is generally considered as one of the key policy resources to inform, support, evaluate and guide Swiss federal activities and strategies[68]. The SERI chairs the permanent interdepartmental coordinating committee for departmental research. At the same time, the SERI itself declares no departmental research. Yet it has commissioned studies on international S&T policy issues which in principle qualify for departmental research, and list expenses for consulting services in its annual financial report. Departmental research is regulated by legal provisions on research management, evaluation procedures, planning processes and public access to information. The SERI currently sidesteps these codes of practice. This situation holds back the effective feedback of its commissioned studies and consulting services into the relevant stages of the policy cycle and their distribution to important S&T stakeholders.

A strategic policy issue because …

- Comprehensive information on key indicators for international S&T policies in Switzerland is not compiled and released publicly, although the RIPA specifies this federal responsibility for areas of national importance.
- The SERI declares no *Ressortforschung* and thereby sidesteps standard reporting, monitoring and management requirements as well as the obligation to secure access to commissioned reports, evaluations and related services.
- International S&T policies affect the activities and responsibilities of a variety of stakeholders in Switzerland. Research institutions, research-promotion agencies, federal departments, business and industry, and the broader public all require basic information on the federal activities, policies and statistics that shape the Swiss response to globalisation in the field of S&T.

Key questions:

- What resources are needed to support policy?
- How can the production of and public access to these resources be promoted?

68 https://www.ressortforschung.admin.ch/rsf/de/home.html, accessed 18.1.2018.

Appendices

Appendix I: List of abbreviations

BRICS	Brazil, Russia, India, China, South Africa
CERN	European Organization for Nuclear Research
CGIAR	Consultative Group on International Agricultural Research
CIESM	International Commission for the scientific exploration of the Mediterranean
CIS	Commonwealth of Independent States
COFER	Consortia for Education and Research
COST	European Cooperation in Science and Technology
CREST	Comité de la Recherche Scientifique et Technique
CRUS	Rectors' Conference of the Swiss Universities
CTI	Commission for Technology and Innovation
DAC	Development Assistance Committee
DATEC	Federal Department of the Environment, Transport, Energy and Communications
DCA	Directorate of Development Cooperation and Humanitarian Aid
DPA	Directorate of Political Affairs (FDFA)
EAER	Department of Economic Affairs, Education and Research
EDK	Swiss Conference of Cantonal Ministers of Education
EEA	European Economic Area
EFHK	Federal Commission for Universities of Applied Sciences
EFTA	European Free Trade Association
EMBC	European Molecular Biology Conference
EMBL	European Molecular Biology Laboratory
ERA	European Research Area
ERAC	European Research Area Committee
ERI	Education, research and innovation
ESA	European Space Agency
ESKAS	Federal Commission for Scholarships for Foreign Students
ESO	European Southern Observatory
ESRF	European Synchrotron Radiation Facility
ESRO	European Space Research Organisation
ESS	European Spallation Source
EU	European Union
EURATOM	European Atomic Energy Community
FA IZ	Specialised Committee International Cooperation
FDEA	Federal Department of Economic Affairs
FDF	Federal Department of Finance
FDFA	Federal Department of Foreign Affairs
FDHA	Federal Department of Home Affairs
FDJP	Federal Department of Justice and Police
FIT	Federal Institutes of Technology
FP	European Research Framework Programme
GAOA	Government Administration and Organisation Act
HFSP	Human Frontier Science Program
IAEA	International Atomic Energy Agency
ICT	Information and Communication Technologies
IEA	International Energy Agency
IEP	International Energy Programmes
IERIS	International Education, Research and Innovation Strategy
ILL	Institut Laue-Langevin, Grenoble
ILO	International Liaison Office
ITER	International Thermonuclear Experimental Reactor
JRP	Joint Research Programmes
KFH	Rectors' Conference of the Swiss Universities of Applied Sciences
KFPE	Commission for Research Partnerships with Developing Countries
LH	Leading House
MoU	Memorandum of Understanding
OECD	Organisation for Economic Co-operation and Development
OEEC	Organisation for European Economic Co-operation
OPET	Federal Office for Professional Education and Technology (FDEA)
PSI	Paul Scherrer Institute
R&D	Research and development
RIPA	Research and Innovation Promotion Act
SDC	Swiss Agency for Development and Cooperation (FDFA)
SDG	Sustainable Development Goals
SECC	Science, Education and Culture Committee
SECO	State Secretariat for Economic Affairs (FDEA)
SER	State Secretariat for Education and Research (FDHA)
SERI	State Secretariat for Education and Research and Innovation
SFAO	Swiss Federal Audit Office
SFIVET	Swiss Federal Institute for Vocational Education and Training
SFOE	Swiss Federal Office of Energy (DATEC)
SME	Small and Medium-sized Enterprise
SNSF	Swiss National Science Foundation
S&T	Science and Technology
STC	Science and Technology Councillors
SUC	Swiss University Conference
SUDAC	Development and Cooperation Network
SUPSI	University of Applied Sciences and Arts of Southern Switzerland
UAS	Universities of Applied Sciences
UN	United Nations
UNESCO	United Nations Educational, Scientific and Cultural Organization
XFEL	European x-ray free electron laser research facility

Appendix II: Research design

The exploratory study was conducted from the analytical perspective of the academic field of Science & Technology Studies (STS). It follows an inductive social science research approach and employs qualitative research tools to pursue the research questions. The study was carried out in three phases:

The *first research phase* explored the historical development of international S&T policies in Switzerland, using the working definition for S&T policies outlined above. Document analysis and interviews served to inform the historical study.

In a *second research phase*, key concepts from policy studies were employed to analyse the features and mechanisms that typify the current era of international S&T policies and set it apart from previous international S&T policies.

In a *third research phase*, the findings of the analysis of these policy features and mechanisms were discussed in relation to the academic literature on S&T policy. The discussion aimed at identifying the broad strategic issues and questions that need to be addressed to strategically enhance sustainable international S&T policies for the future.

The term 'international S&T policies' is referred to as an umbrella phrase for the purposes of the exploratory study to name a group of related terms that have been used over the course of history. The following definition is adopted for the term 'international S&T policies' as unit of analysis of the exploratory study:

'International S&T policies' designate governing actions and responsibilities (at federal and cantonal level) that concern matters relating to science and technology beyond the boundaries of the nation state. Governance occurs by way of rules, norms and official decisions (legislation, statutory orders, decrees by government agencies or public administration), particularly through the allocation of financial resources.

The term 'international S&T policies' is used as an overarching category for the purpose of empirical research (Glaser & Strauss, 1967; Strauss & Corbin, 1990). The term is chosen to name the object of study without reference to a theoretical framework. It is treated as a concept that has no historical consistency and displays irregular contours. It acquires its meaning through its relationship of associated concepts. Therefore, the historical development of the concept of international S&T policies is essential to explain its current disposition and significance. This approach requires an analytic cycle of document analysis that includes an extensive literature review, document coding and categorising.

The *sources* consulted for the document review include Federal Dispatches for research, innovation, technology; federal reports published by the Federal Council, the SERI, the Swiss Federal Audit Office (SFAO) and others; reports and documents of the Swiss Science Council SSC; policy documents by public administration, research-promotion agencies, higher education institutions, legislation and international agreements; expert interviews; internet websites of federal agencies, research-promotion institutions, higher education institutions; and academic literature.

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