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Swiss National Open Science Strategy
Version 2

Submitted for approval by the committee of swissuniversities

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Legal mentions	
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Table of contents

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1. Mandate

In December 2018, the swissuniversities committee validated the draft for federal project contributions for “Open Science: FAIR Services for Scientific Information” and asked the Scientific Information Program to elaborate a new strategy and action plan based on this draft.
In May 2019, the SHK (Schweizerische Hochschulkonferenz) invited swissuniversities to submit a full proposal based on it (See Annex A for abbreviations).
In addition, the SERI commissioned swissuniversities to extend the National Strategy on Open Access towards Open Research Data and to coordinate stakeholder activities in partnership with the SDSC, SWITCH and SNSF (See Annex B).
This document presents the National Strategy for Open Science in Switzerland for 2021-2028, taking these requirements in consideration, and including the Swiss Academies of Sciences in the consultation as well. It serves as a basis for the two successive National Open Science Action Plans of 4 years each to complete this strategy.

2. Introduction

Open science commonly refers to efforts to make publicly funded research widely and readily available in digital format to the academic communities and society in general.
The benefits from open science are numerous and various. Next to the understanding of research and teaching for the good of the public, open science strongly fosters scientific integrity, supports the crucial criteria of good scientific practice and ensures the transparency and verifiability of research results beyond the mere publication of articles and books.
Taking in consideration the international efforts towards Open Science, as for instance (EC - Turning FAIR into Reality 2018) (LERU 2018), our strategy addresses the whole lifecycle of research, innovation and teaching. It covers the collection and management of digital objects such as journal articles, research data, learning and training material, the development and application of open and shared research methodologies, and the interoperability of services and digital infrastructures. It encompasses as well the rapid translation and development of applications (Open Innovation), the open use of scientific knowledge by the public and especially in the field of education by students, teachers and lecturers (Open Education), and the citizen’s inclusion in the scientific progress (Citizen Science).
We therefore define open science as follows:

Open science is about the way research, education and innovation are carried out, disseminated, deployed and transformed by digital tools, networks and media. It relies on the combined effects of technological development and cultural change towards collaboration and openness throughout the spectrum of scientific activities. Open science makes scientific processes more efficient, transparent and effective by offering new tools for scientific collaboration, experiments and analysis and by making scientific knowledge as openly findable, accessible, interoperable and reusable (FAIR) as possible

The scope of our definition of open science, which encompasses FAIR principles in a more general context than only for research data, also fosters the collaboration among institutions and the dialogue between science, society and the economy.
This strategy is setting the ground for mutualising collaboration between Higher Education Institutions (HEI) and scientific communities. This collective effort will strengthen the constitutive role open science in the society by enabling participation and trust in science.
This strategy further extends the Open Access Strategy (Stratégie Nationale sur Open Access 2017), which remains valid on its own, and the Open Science Action Plan will integrate and refine the Open Access Action Plan (Plan d'Action National sur Open Access 2018) already in implementation since then.

The time horizon of this national strategy covers the period 2021-2028. It will be implemented across two national action plans, one for the period 2021-2024 (including the Open Access Action Plan 2021-2024), and another one for the period 2025-2028.
After outlining the current situation from the different stakeholders' perspectives, and analyzing it, we find common objectives building the core of the strategy, and sketch the activity fields that will be developed in the resulting Action Plan 2021-2024.

3. Current situation

Science is globally facing several challenges, as well as very stimulating opportunities.
As far as challenges are concerned, reproducibility and replicability prove to be hard to achieve, to quote a few of the pillars of evidence and trust in new knowledge. In addition, scientific results are facing more and more skepticism in particular when confronted by fake news in society, politics and in the media. In addition, the independence of science is under pressure, be it for economic, political or other reasons, which threaten its freedom in several countries around the globe.
Academic publishing itself is integrating the publication of the additional digital objects into its processes and in particular the research data needed to verify the article claims and results. Scientific publishing groups are setting up for-profit services (including for instance data publication, data analytics, artificial intelligence, online learning management tools) in order to further strengthen their control over open research data as well. In addition to the challenges posed by open access to publications, the open science strategy is facing the new challenge of controlling access to open research data.
Besides those challenges, information and communication technologies (ICT) have brought tremendous opportunities to the development of science, education and innovation, to the reinforcement of transparency, and to the stimulation of sharing and spreading scientific knowledge around the world. ICT allow new forms of collaborations and partnerships, of research outputs and credits and support increased efficiency, as well as new forms of learning and teaching. Empowering all stakeholders to seize these opportunities is at the heart of this strategy.
The European Union has taken on a leading role in setting open science at the forefront of its Digital Single Market Initiative and in fostering free circulation of knowledge, as soon as it is available, using digital and collaborative technology (EU Recommendation on Scientific Information 2018). The OECD as well studied in more details the different economical models behind open research data and their sustainability (OECD Global Science Forum 2017), and several other international initiatives are supporting this drive to open science on global level.
In parallel, the efforts made by the individual scientists themselves to integrate the open science values and practices should be recognised appropriately. The policies dealing with this recognition, summarized in the Declaration of Research Assessment (also called DORA)[1] suggest incentives and rewards as essential mechanisms to ensure the engagement of all members of the scientific community in the needed cultural change leading to more sharing and collaboration. The adoption of DORA requires as well the involvement of all stakeholders (several HEI and the SNSF have signed the DORA declaration already), at the HEI rectorates, the heads of departments and faculties, as well as support from the human resources services within the institutions.
In March 2018, the European Commission adopted an Implementation Roadmap for the European Open Science Cloud, with the intention of creating a fit for purpose pan-European federation of research data infrastructures, in order to move from the current fragmentation to a situation where data is easy to store, find, share and re-use (European Union 2019). Switzerland has delegates in the five EOSC working groups contributing to the implementation of EOSC[2]. The e-IRG Reflection Group recently published a policy paper on National Nodes in view of the implementation of EOSC, in which Switzerland is also covered (e-IRG

1 https://sfdora.org/
2 https://www.eoscsecretariat.eu/eosc-working-groups

2019). Sustainable funding for national open science digital infrastructures has become a recurring subject of new policies established in several EU countries, like Sweden (Swedisch Research Council 2019) or Germany[3]. In the USA, many data-driven initiatives have been launched recently, in particular under the sponsorship of the NIH[4]. For instance, the Data Science "STRIDES" accelerates discoveries in the cloud, as part of the NIH Common Fund's New Models of Data Stewardship Program. It harnesses the power of the commercial cloud and provides NIH biomedical researchers access to the most advanced, cost-effective computational infrastructure, tools and services available[5].

Switzerland has also drawn up a digital strategy indicating where and how authorities, academia, the private sector, civil society and politics must work together to shape the transformation process for the benefit of everyone in Switzerland (Swiss Federal Office of Communications 2018).

Increasingly during the last two decades, technologies and innovations such as smartphones have opened opportunities for new forms of engagement of individuals and communities with science and education. This includes multiple sources of data generated by citizens, who actively contributed through approaches such as citizen science, or passively through, for instance, social media, location-aware mobile phone data, and individual health data. This development also provides multiple opportunities of participation and collaboration between scientific and non-scientific actors, their joint participation in certain scientific or technological advances or the empowerment of society (e.g. by giving patient associations and NGOs access to scientific publications and data, etc.), while of course preserving the privacy rights of the data subjects and data owners as well.

«Global issues like climate, biodiversity and environment call for both large data sets and engagement at a local level. Scientists must play a crucial role in supporting public learning and understanding of science and furthering citizen engagement in the scientific process. Scientists themselves should play a key role in bridging the culture gap between the public and the scientific community»

Danièle Pralong, PhD, Citizen Science

GLOBAL ISSUES, BIG DATA, ENGAGEMENT, PUBLIC LEARNING, UNDERSTANDING OF SCIENCE

Limiting the concept of "opening science" to either the contributions of citizen to science or to the accessibility and transparency of data to citizens is not sufficient. Open science, innovation and education need to include society and the economy more profoundly and co-create the skills and tools necessary to foster a reflective interpretability and usage that would bring true value and knowledge, while respecting transparency, ethics and privacy. Digital capabilities, both in terms of technical and literacy skills, include today everyone's ability to orient themselves when facing fake news, alternative facts and misinformation. Lifelong learning plays a crucial role in this context by recognising the strong relationship between research, teaching and innovation as a major benefit to individuals and society (including the school system). Higher education institutions have to respond to these diverse demands within the society and acknowledge the diversity of individual learners needs providing appropriate guidance and study programs.

The institutional perspectives of the principal stakeholders active in open science in Switzerland (Swiss National Science Foundation, Higher Education Institutions, Swiss Data Science Center, National Scientific Information Program, Swiss Academies of Arts and Sciences, SWITCH) are presented in Annex C.

3 https://www.forschungsdaten.org/index.php/Nationale_Forschungsdateninfrastruktur_-_NFDI
4 https://datascience.nih.gov/strategicplan
5 https://www.nih.gov/news-events/news-releases/nih-makes-strides-accelerate-discoveries-cloud

4. Analysis

The analysis is presented here as a list of strengths, weaknesses, opportunities and threats, based on the experience and specific expertise provided by the project group members, as well as several recent documents / studies (for a non-exhaustive list please see our bibliography).

4.1. Strengths

- The worldwide reputation of Swiss scientific excellence
- The commitment of Swiss HEI and their scientific libraries offering services to their research and student customers in open science related matters
- The engagement of the scientific communities and the HEI in scientific information activities and shared services via the participative and bottom-up approach followed by the Scientific Information Program
- The amount of participation of Swiss HEI at international level - Swiss institutional partners are involved in 25% of today's research data repositories worldwide (Heyde 2019)
- The performant underlying National Research and Education Network (swissuniversities - Network of ICT Experts 2019)
- The decentralization and high diversity of the Swiss scientific landscape (Swiss Academies of Arts and Sciences 2019)
- The established National Open Access Strategy (SNSF and swissuniversities 2017) and Action Plan (SNSF and swissuniversities 2018)

4.2. Weaknesses

- The low level of usage of research data repositories - more than 90% of the data within those repositories belong to only 3% of scientists (Digital Science 2018)
- The low adoption level of FAIR principles (Heyde 2019), and of discoverability
- The low level of today's mutualization of digital infrastructures and of their governance (Heyde 2019)
    - The very broad and different understanding, approach and set of measures on Swiss HEI's road to open science (swissuniversities 2019)
    - The low level of activity in application domains like Citizen Science, Open Innovation or Open Education in Swiss HEI (swissuniversities 2019)
- The low number of Swiss HEI offering Research Support Platforms and scientific IT-Services (swissuniversities 2019)
- The inadequacy of the project-based funding for supporting sustainable digital infrastructures

4.3. Opportunities

- The commitment of all stakeholders in facilitating the replication and reproducibility of scientific results (EPFL Magazine 2017)
- The diverse needs of different scientific communities which could benefit from translating approaches, methods, and dedicated user experiences developed in other scientific communities and facilitating interdisciplinary collaborations
- The stability, wealth and attractiveness of Switzerland and Swiss HEI in international comparison

- The commitment of Swiss scientific libraries to adapt their mission to the needs of the scientific community through research data management
- The high quality of the education level in Switzerland facilitating the dialogue between science, economy and society, thus easing the engagement of external partners (companies, citizen, institutions, NGO) to collaborate with scientists
- The readiness of Swiss HEI and national bodies, to foster collaboration and coordination at national and international level

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4.4. Threats

- The lack of skilled and trained people in research data management, stewardship, curation, and in sharing practices and policies (swissuniversities - Network of ICT Experts 2019)
- The lack of compliance of repositories to FAIR principles - 25% of repositories are not interoperable (Heyde 2019)
- The control exerted by international scientific publishers over the access to publications and data, via their developing service portfolio (SPARC Landscape Analysis 2019)
- The low level of recognition for open science related activities in the career paths of individual scientists
- The very highly competitive culture in which science has been developing

5. Objectives

Based on the analysis provided in the previous chapter, and targeting the aims described in the introduction, the strategy is focusing on four main common objectives.

5.1. Improving shareability and interpretability

Sharing of digital objects requires a paradigm change in handling of digital objects, in particular the research data. This can be achieved by adopting international open standards (semantic, ontologies, open source, protocols, etc.) whenever available and by enforcing their usage.

Research data is a typical example of such a digital object. “Quality-assured research data are key building blocks of the research processes”, as Science Europe suggests (Science Europe 2019). Making research data FAIR enables data mining and facilitates the reuse and reproducibility of research findings, as promoted in the European Code of Conduct for Research Integrity (ALLEA 2017), or the GO-FAIR initiative[6], and thereby fosters the robustness and integrity of scientific findings. This includes the sharing of computational knowledge (research software, knowledge graphs and scripts), the acceleration of the adoption of software tools and platforms for FAIR data and open science, as well as the compliance with international standards and reference models equally essential to ensure the reusability or the reproducibility of the research findings.

6 https://www.go-fair.org/

Research data management, open research data and FAIR data are related to the entire research lifecycle and are an integral part of scientific practices. They support the availability of research results and address questions of reusability during active research as well as after the end of a project.

« The full circle of Open Science should be the default position also in the humanities and only with good reason one should deviate (like personality rights etc.). Cultural heritage, which is by definition a world heritage and should be therefore publicly available, including tools, scripts, and ontologies on stable, long-term infrastructures»

Prof. Dr. Gerhard Lauer. Universitv of Basel

OPEN SCIENCE AS DEFAULT, REUSABILITY

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This objective contributes to increased accountability, transparency and efficiency. Digital objects like research data, educational material, and digital infrastructures and services that exist already will be available and usable for others to build on it in a collaborative and cumulative manner. It fosters the use of research outcomes in education as well, at a national level, and strengthens the role of Switzerland in the development of science at an international level.

> Implied activity fields: “Open Access” and “FAIR Data & Services”.

5.2. Leveraging decentralisation and diversity

In order to realise Open Science with respect to diversity and decentralisation, such endeavours require crossing numerous borders whereby decentralised digital objects storage and access, and interoperable frameworks at all levels, including data, semantics, legal and ethical aspects, will be required.

It will also require supporting decentralised and incremental data analytics, promoting and accelerating the use of data via data science, machine learning and artificial intelligence methods.

It further needs to take into account the development and adoption of discipline specific conventions and needs regarding the handling of digital objects for future use. The decision on when and which digital objects or data has to be stored (and made available to others) and when or which one can be deleted is highly domain or discipline specific. It will be increasingly expensive to store just *all* data and also the amount of data will increase quickly based on the ever more sensitive scientific equipment becoming available.

This decentralisation needs a counterbalancing effort mutualising the development of an ecosystem of Infrastructures for example for research data management and repositories

A selected set of digital infrastructures funded on long-term or as emerging digital infrastructures will prevent a further fragmentation of efforts, tools, systems and methods used in research data management. They should be connected internationally and ensure interoperability with each other as well as with other open resources if available, in order to ensure the proper embedding of Swiss science internationally, in a discipline-specific manner, with a stronger and more visible Swiss-based scientists involvement.

As reported by the e-IRG recent publication (e-IRG 2019), the success of EOSC will rely upon a coordinated backbone or network of e-infrastructures and services at national level, which all endorse internationally adopted standards. The governance of this network itself requires coordination at national level, under very clear leadership, and a very pro-active involvement in international initiatives such as CODATA or the Research Data Alliance, as well as in branch-specific ones like for example DARIAH in the digital humanities, ELIXIR in the life sciences, or CESSDA in the social sciences[7].

7 https://www.codata.eu/ https://rd-alliance.org/ https://www.dariah.eu/ https://elixir-europe.org/ https://www.cessda.eu/

> Implied activity fields: “Open Access”, “FAIR Data and Services”, and “Research Data Digital Infrastructures”.

5.3. Strengthening the dialogue between science and the society

The knowledge production process is experiencing a paradigmatic change as well, that could lead to strengthen the positive impact of science in society.

This change is building upon the competences available inside and outside the academic world. It integrates new processes such as companies taking advantage of data and technology to interact with their client base and offer personalised experiences.

It also integrates new behaviors, enabled by the availability of low cost technologies and by citizen science approaches, such as people voluntarily contributing their own personal and medical data to advance health research, or communities generating scientific data and knowledge on water and air quality, marine litter, biodiversity, for instance[8]. However, for citizens it is no longer sufficient to provide passive lists of observations and data to serve scientific purposes, they want to use their findings to contribute to informed decision and policy-making.

The sharing of educational resources and contents promotes and supports openness in education. Open Education as well establishes and shares other types of digital objects like learning and teaching material. Open education requires appropriate resources, tools and practices to meet initial discourses and ultimately the demands of quality.

« ScorePad is a Swiss SME using lots of different technologies like deep learning algorithms to convert paper to digital music. In order to create better products and services in the future we have to do collaborative research and development all over the world to benefit from same base technologies and avoid “reinventing the wheel”. It would be brilliant to have access to a platform where we can easily find research and development teams to take part of and share the results »

Florian Seibold, ScorePad

COLLABORATIVE RESEARCH, SAME BASE TECHNOLOGIES

In parallel, given that 66% of research and development investment stems from the private sector in Switzerland (Swiss Federal Office for Statistics 2019), improving shareability among private and public research data should provide mutual benefit to both parties to maintain the competitive advantage Switzerland benefits from in science-driven and Open Innovation.

In adopting this strategy, swissuniversities members contribute to the challenging reorganisation of this larger ecosystem, on a national and international scale. This includes better accessibility and interpretability of digital objects by the scientific community, but also the implementation of tools and the availability of methodologies and knowledge to empower citizens and their representatives to take evidence-based decisions and contribute in tackling societal challenges, and thus contributing as well to reaching the Sustainability Development Goals of the United Nations.

> Implied activity field: “Exploratory and Integrative Services”

5.4. Adoption of Openness and FAIRness

Besides technical issues mentioned in the first objective, the strategy also requires a very deep cultural change in the fabric of science itself, calling for much more openness and cooperation among scientists and among their institutions as well. This will be essential to counteract the fierce competition that scientists are facing in the current publish-or-perish

8 https://www.schweiz-forscht.ch

paradigm, now extending to data publication too, as well as the competition that rankings induce among scientific institutions.

Open science can be put into practice by convincing junior researchers in particular. Their research careers are already affected by using interoperable repositories, and they are the future bearers of a new open science culture.

Dr. Andrea Malits, Hauptbibliothek, Universität Zürich

INTEROPERABILITY, NEXT GENERATION, CONNECTING

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Providing researchers with the skills and tools to properly document their studies will ultimately foster trust and excellence in science. Researchers must be able to trust published research, even when the data is not made public.
A key asset for this change of culture to happen will be to ensure the proper awareness raising and skills development both for scientists themselves, as well as for the new professions emerging in the field of research data management (stewardship, curation, analysis, record-keeping, etc). A coordinated effort has to be made to reach out and train scientists about openness and FAIRness in that context. Empowering all members of the scientific community in developing their skills to enable them to contribute to research and teach integrity (see objective 5.1) will constitute the first stage of our strategy towards adoption.
The next stage will introduce the additional necessary framework (e.g. national or institutional policies, guidelines, recommendations) deemed necessary to complement the incentives/rewards proposed at the present stage. The right mix of instruments will follow the analysis of these first-stage's results, and will therefore be included in the subsequent Action Plan 2025-2028.
The current strategy therefore naturally couples with the activity on "Research Assessment" within the Open Access Action Plan. This activity is not confined to open access though. It links to the open science strategy as a whole. As it is crucial within HEI and at national and international level to guarantee equitable conditions for all scientists in the still very highly competitive conditions they are facing, Research Assessment inherits its own activity field within this strategy.

> Implied activity fields: "Open Access", "Research Assessment" and "FAIR Data and Services".

6. Fields of Activity

The fields of activity for the period 2021-2024 are described with their action lines:

1. **Open Access**: This field of activity gathers the following action lines (as described in the OA Action Plan for phase 2021-24) – communication and awareness raising, setting up of shared services and digital infrastructures (OA Platforms and funding), the participation in international initiatives and digital infrastructures by HEI, and alternative forms of publications, national monitoring and negotiations with publishers.
2. **Research Assessment**: Revising the way scientists and HEI are assessed with respect to their achievements related to research constitute an essential activity field in supporting the necessary cultural change towards open science, by respecting the autonomy of the individual HEI.
3. **FAIR Data and Services**: This field of activity will develop HEI's capacities with an interdisciplinary perspective. The action lines will focus on communication and awareness-raising, skills development and training, initiating shared open science services, making existing digital infrastructures (principally repositories) and services FAIR principles compliant, supporting the joint participation of Swiss HEI in international Open and FAIR Data initiatives and digital infrastructures.
4. **Exploratory and Integrative Projects:** This field of activity targets Open Innovation, Citizen Science and Open Educational Resources, through collaborations among HEI and their affiliates and integrating external partners into projects, strengthening the dialogue between academia, enterprises and the society. Co-funding from external partners is expected in the Open Innovation Action Line.
5. **Research Data Digital Infrastructures:** This field of activity will focus on developing sustainable funding (therefore not on a project-based funding source) for existing and emerging national digital infrastructures.

You will find more details about the fields of activity and their action lines, the roles of the different stakeholders, and the quantitative goals for each objective in the resulting Swiss National Open Science Action Plan for the period 2021-2024.

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Annex A: Abbreviations

Abkürzungen / Abbréviations / Abbreviations	
APC/BPC	Author/Book Processing Charges
COSI	Coordination Office for Scientific Information
EU/UE/EU	Europäische Union / Union européenne / European Union
e-IRG	e-Infrastructures Reflection Group
EOSC	European Open Science Cloud
FAIR	Findable, Accessible, Interoperable and Reusable
NICT	Network ICT Services for Swiss higher education
NIH	National Institute of Health (USA)
OECD	Organisation for Economic Cooperation and Development
SBFI / SEFRI / SERI	Das Staatssekretariat für Bildung, Forschung und Innovation / Le Secrétariat d'Etat à la formation, à la recherche et à l'innovation / State Secretariat for Education, Research and Innovation
SDSC	Swiss Data Science Center
SHK / CSHE	Schweizerische Hochschulkonferenz / Conférence suisse des hautes écoles
SNF/FNS/ SNSF	Schweizerischer Nationalfonds / Fonds national suisse / Swiss National Science Foundation
SWITCH	SWITCH offers collaboratively developed ICT solutions that empower users in and beyond the academic world to achieve leading edge results in a globally competitive environment.

Annex B: Letter from swissuniversities, SNSF and ETH presidents to SERI

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Bern, 12. Juli 2019

Entwicklung einer nationalen Strategie Open Research Data

Sehr geehrte Frau Staatssekretärin

Wir danken Ihnen für Ihr Schreiben vom 12. Juni 2019. Gerne nehmen wir Ihren Auftrag an swissuniversities entgegen, die Verantwortung für die Entwicklung einer Nationalen Strategie Open Research Data inklusive Umsetzungsplan zu übernehmen. Wir teilen Ihre Einschätzung, dass der Umgang und die Nutzung von wissenschaftlichen Daten ein zentrales, zukunftsträchtiges Entwicklungsfeld ist und dass ein koordiniertes Vorgehen essentiell ist für den Hochschulraum Schweiz.

Gerne geben wir Ihnen einen Überblick über die vielfältigen Arbeiten, die in diesem Bereich schon umgesetzt resp. gestartet sind.

- Ein zentrales Anliegen einer Strategie FAIR Data, welche auch Open Data umfasst, ist das Teilen von Forschungsdaten. Dabei liegt die Priorität darauf, Daten mit einer angemessenen Zugangskontrolle in der Forschung wiederverwenden zu können. Wir sind der Ansicht, dass hinsichtlich der dafür nötigen **Repositorien** die Bedürfnisse der Schweizer Forschungslandschaft abgedeckt sind. Die vom SNF und swissuniversities im vergangenen Jahr initiierte Studie[1] hat gezeigt, dass keine relevanten Lücken bestehen und dass die Forschenden ausreichend Optionen haben, ihre Daten in angemessenen Repositorien zu hinterlegen.

  Die **Kosten**, welche der Schweiz für die Benutzung dieser Repositorien entstehen, werden sich mit zunehmendem 'Daten-Bewusstsein' der Forschenden entwickeln. Im Hinblick auf die BFI-Periode 2021-2024 werden wir in den nächsten Monaten die erwähnte Studie auf diesen Punkt hin nochmals vertieft analysieren. Wir gehen davon aus, dass die Finanzplanungen, welche die BFI-Akteure für die BFI-Botschaft 2021-2024 vorgelegt haben, die nötigen Mittel schon umfassen. Bis zur Planung der BFI-Periode 2025-2028 werden voraussichtlich mehr und bessere Daten zur Vorhersage der Kostenentwicklung vorliegen.

[1] "Open Research Data: Landscape and cost analysis of data repositories currently used by the Swiss research community, and requirements for the future"; M. von der Heyde; https://zenodo.org/record/2643460

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Damit die Forschenden ein wirkungsvolles Datenmanagement betreiben können, muss die gezielte **Ausbildung** verstärkt werden. Dieser Punkt ist schon im Aktionsplan zur Nationalen Open-Access-Strategie angesprochen, und das Programm P-5 «Wissenschaftliche Information» (und sein Vorgänger SUK-P2) hat wichtige Projekte unterstützt, welche Lösungen für das Management von Forschungsdaten anbieten.[2] Auch im zukünftigen PgB Open Science (siehe unten) soll ein Schwerpunkt auf der Ausbildung der Forschenden liegen.

- In der Strategischen Planung 2021-2024 hat swissuniversities der SHK Ende 2018 eine Projektskizze **„Open Science: FAIR services for Scientific Information"** mit einem Antrag über CHF 45 Mio. Bundesmitteln vorgelegt. Der SHK Hochschulrat hat im Mai 2019 beschlossen, das Projekt mit dem beantragten Beitrag weiterzuverfolgen, und entsprechend wird swissuniversities der SHK im Februar 2020 einen umfassenden Programmantrag einreichen.

- Im gleichen Kontext hat swissuniversities das Konzept für ein **„Coordination Office for Scientific Information"** (COSI) entwickelt und dafür Ende 2018 dem SBFI einen Antrag auf CHF 2 Mio für eine gemeinsame Infrastruktureinrichtung gemäss Art. 47 Abs. 3 HFKG eingereicht. Diese Koordinationsstelle wird operativ in SWITCH integriert sein und soll die Schweizer Hochschulen darin unterstützen, ein Portfolio gemeinsam genutzter Dienste aufzubauen und zu unterhalten.

- Im Frühling 2018 hat der Bundesrat in der Standortbestimmung zur „Datenpolitik der Schweiz"[3] den ETH-Bereich beauftragt, für seine Forschungsbereiche „die Voraussetzungen für die Zugänglichkeit von geeigneten Forschungsdaten" zu definieren und im Hinblick auf die BFI-Botschaft 2021–24 geeignete Massnahmen vorzuschlagen. Eine entsprechende Absichtserklärung ist in der Strategischen Planung 2021–24 des ETH-Rats enthalten, und erste Arbeiten sind im ETH-Bereich im Gange.

- Die wissenschaftliche Nutzung von grossen Datenmengen wird künftig eine wichtige Kompetenz sein. Das 2017 vom ETH-Bereich lancierte **Swiss Data Science Center SDSC** wird deshalb künftig Forschenden aller Universitäten, Fachhochschulen und Pädagogischen Hochschulen offen stehen und auch bei der Ausbildung (siehe oben) eine wichtige Rolle übernehmen. Für die zusätzlichen Kosten sollen auch Mittel aus dem künftigen PgB Open Science eingesetzt werden.

- Ebenfalls im Auftrag des Bundesrates wird der SNF in der BFI-Periode 2021-2024 sein Aufgabenportfolio um die Förderung von ausgewählten Dateninfrastrukturen und Dienstleistungen von gesamtschweizerischer Bedeutung erweitern. Dabei ist eine gute Koordination mit dem PgB Open Science erforderlich, ebenso eine Berücksichtigung im nationalen Aktionsplan Open Science.

Die hier skizzierten Vorhaben bewegen sich in einem Umfeld, in dem sich die Technologien und damit auch die Möglichkeiten sehr rasch wandeln. Es ist essentiell, dass Plattformen bestehen, wo alle Akteure in der Schweiz ihre Interessen und Anliegen diskutieren und dass

[2] z.B. swissbib, Train2Dacar, DLCM (Data-LifeCycle Management), OpenRDM (Research Data Management), SLSP oder EnhanceR
[3] «Massnahmen für eine zukunftsorientierte Datenpolitik der Schweiz», 9. Mai 2018; https://www.admin.ch/gov/de/start/dokumentation/medienmitteilungen.msg-id-70594.html

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die vorhandenen Finanzmittel koordiniert und wirkungsvoll eingesetzt werden. Dafür sehen wir folgende Instrumente und Steuerungsgremien vor:

- Im Dezember 2018 hat der swissuniversities Vorstand entschieden, eine neue **Delegation Open Science** einzusetzen. Diese wird die strategische Koordination im Bereich Open Science und auch die Zuständigkeiten des Lenkungsausschusses P-5 übernehmen. Im Juni 2019 wurden das Mandat und die Zusammensetzung[4] festgelegt, so dass die Delegation Open Science im Herbst 2019 ihre Arbeit aufnehmen kann.

- In Vorbereitung des künftigen PgB Open Science wird z.Z. eine **Strategie Open Science** erarbeitet. Der Vorstand von swissuniversities hat im Juni 2019 beschlossen, diese zur Nationalen Strategie zu erweitern. Sie soll die schon bestehende Nationale Strategie Open Access umfassen und die strategischen Ziele im Bereich FAIR Data und anderer Dimensionen von Open Science beschreiben. Ein Entwurf dieser Strategie soll im September 2019 bei den BFI-Partnern in Konsultation gehen. Anschliessend soll sie, analog zur Nationalen Strategie Open Access, von der swissuniversities Plenarversammlung und anschliessend vom SHK Hochschulrat verabschiedet werden. In der vorbereitenden Arbeitsgruppe war namentlich auch das SDSC mit seinem Direktor vertreten, und künftig soll auch der SNF einbezogen werden.

  Die Strategie Open Science wird durch einen **Aktionsplan Open Science** ergänzt werden, welcher Mitte Oktober 2019 an einem Kick-off an der EPF Lausanne lanciert wird und dann in den folgenden Monaten ergänzt und finalisiert werden wird. Das Programm P-5 hat auch dafür grundlegende Dienstleistungen entwickeln, die für die Umsetzung einer Open-Science-Strategie unerlässlich sind.[5]

- Unter der Verantwortung der Delegation Open Science wird auch die Programmskizze des **PgB Open Science** zu einem Programmantrag ausformuliert und im Februar 2020 der SHK vorgelegt werden. Dabei wird die Delegation die Rückmeldungen des SHK Hochschulrates vom Mai 2019 ebenso wie die jetzt laufenden Gespräche und Anliegen des SBFI diskutieren und aufnehmen.

  Im Weiteren wird auch die strategische Steuerung von COSI in der Zuständigkeit der Delegation Open Science liegen.

Abschliessend ist uns wichtig festzuhalten, dass (1) die Schweizer Hochschulen sich in einem internationalen Umfeld bewegen, also auch von internationalen Entwicklungen beeinflusst sind, und dass (2) es auch Konstellationen gibt, die eher von Konkurrenz als von offener Zusammenarbeit geprägt sind. Wenn nun auch nicht alle Akteure im BFI-Umfeld über die gleichen (finanziellen und technischen) Möglichkeiten zur Gestaltung von eigenen Instrumenten verfügen, so müssen zwar die Hochschulen an der Weltspitze weiterhin aktiv gefördert werden, es darf aber auch nicht bedeuten, dass andere wissenschaftlichen Inhalte we-

[4] Die Delegation Open Science umfasst 4 Vertreter/innen der universitären Hochschulen (davon eine/r von jeder ETH), 2 Vertreter/innen der Fachhochschulen, 1 Vertreter/in der Pädagogischen Hochschulen, 1 Vertreter/in des „Swiss Library Network for Education and Research" (SLINER) und 1 Vertreter/in des „Network ICT Services for Swiss Higher Education" (NICT). Der SNF wird als ständiger Gast eng in die Arbeiten einbezogen sein.
[5] z.B. Swiss EDU-ID, NIE-INE, e-codices, e-rara, CCDigital-Law, SONAR und SLSP; für eine vollständige Liste der Projekte: www.swissuniversities.ch/tec

niger relevant wären oder weniger unterstützt werden sollten. Im Sinne der Weiterentwicklung des Schweizer Hochschulraums gilt es diese Aspekte angemessen und umsichtig zu berücksichtigen.

Wir danken für die Zusammenarbeit zugunsten des Schweizer Hochschulraums, und wir stehen für weitere Fragen gerne zur Verfügung.

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Freundliche Grüsse

Prof. Dr. Michael O. Hengartner
Präsident swissuniversities

Prof. Dr. Matthias Egger
Präsident des Nationalen Forschungsrates SNF

Prof. Dr. Joël Mesot
Präsident der ETH Zürich

Prof. Dr. Martin Vetterli
Präsident der EPF Lausanne

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Annex C: Key Stakehoders Perspectives

SNSF perspective

The SNSF values research data sharing as a fundamental contribution to the impact, transparency and reproducibility of scientific research. Grantees are expected to ensure that data generated by funded projects are publicly accessible in digital databases provided there are no legal, ethical, copyright or other issues.

Since October 2017, researchers have to include a data management plan (DMP) in their funding application for most of the funding schemes. The SNSF provides best practice guidelines in this respect, but gives each scientific community sufficient flexibility in defining and applying its own standards. In particular, the best way of managing and sharing data depends on the research field. The costs of enabling access to research data are eligible within SNSF grants under certain conditions.

To guarantee the quality, collection, storage and accessibility of data and thus increase the overall reproducibility and impact of science, specialised digital infrastructures are necessary. Based on a mandate from the SERI, the SNSF aims to contribute to these developments and extend its portfolio to support research-driven Digital Infrastructures and Services (DIS) of national importance. It hopes to help in improving the overall quality of research-enabling DIS by implementing rigorous and transparent selection and evaluation procedures. Together with the other Swiss stakeholders involved, the SNSF actively follows international developments and contributes to the implementation of EOSC.

Swiss higher education institutions perspective

As described in the framework of their global strategy[9], swissuniversities members agree to tackle the opportunities and challenges that digitalisation brings by opening up science, education and innovation, designing the necessary infrastructures and services and making them as open and FAIR as possible. They agree to make their research contributions FAIR in accordance with international standards and guidelines, with particular attention in optimizing cost development at the national level.

The main results of the survey conducted by swissuniversities in March 2019 on the digitalization strategies in HEI (specifically on open access and open data) are mentioned in the context of the analysis chapter of the strategy.

SDSC perspective

The Swiss Data Science Center (SDSC), a joint venture between EPFL and ETH Zurich, is today a respected entity, with strong expertise and offerings in the full data lifecycle management, from the management of research and scientific data to the acceleration of its use via methods in data science and artificial intelligence. The SDSC collaborates with academia, the public sector and industry at the national level, fostering excellence in multi-disciplinary data-driven research, accelerating best practices in FAIR data and Open Science, as well as promoting innovation.

Since 2017 the SDSC is articulated around a unique model across the two Federal institutes that has proven successful: enabling the mutualisation of effort and resources while preserving the stakeholders' autonomy.

In order to play a leading role in the new data-driven world we live in, there is an urge for Switzerland to join forces. By enabling the extension of this distinctive positioning to academic institutions nationwide, the Swiss HEIs would be able to federate resources that could nevertheless stay independent while enabling adoption of data-driven open science at a scale only possible when pooling resources.

9 https://www.swissuniversities.ch/de/themen/hochschulpolitik/strategie-und-planung/

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Scientific Information Program perspective

In 2014, the swissuniversities Rectors' Conference developed the national strategy "Scientific information: access, processing and safeguarding"[10]. The two programmes SUC P-2 (2013-2016) and P-5 (2017-2020) allowed for the co-funding of 34 projects, 11 of which are already providing services. The major challenge has been the transition from successful projects into sustainable services. A new service, entitled COSI (Coordination Office for Scientific Information), will be set up to support this transition from projects to services[11].
So far, the Scientific Information Program has focused on access to publications and research data management, sharing best practices for learning and teaching these new scientific methodologies and requirements across fields and sectors, and optimising the solutions and tools required for accessing and sharing data. Many of the resulting services in operations (or close to operations) concern open access and open data, and will need further support on their way to FAIR compliance. This leads to a progressive transition between the P-5 (2017-2020) and the new open science programme for the period 2021-2024.

Swiss Academies of Arts and Sciences perspective

The Swiss Academies of Arts and Sciences advocate an equitable dialogue between science and society, and they provide advice for politics and society in science-based issues that are societally relevant. They represent sciences across institutions and disciplines, and they play an important role within the scientific communities in order to foster a shared understanding of open science concepts[12]. In the coming years, they will concentrate their efforts on the core Mission „Science and Society" and on their strategic focus areas digitalisation, health and sustainable development, all of which are strongly related to open science as well as scientific integrity. They contribute actively to the development of specific e-Infrastructures and services linked to the science and society dialogue.
The Swiss Personalised Health Network (SPHN) is a national initiative commissioned by SERI and FOPH designed to promote the development of personalised medicine and healthcare in Switzerland. SPHN contributes to the development, the implementation, and the validation of a nationally coordinated infrastructure required to make health-related data interoperable and exchangeable across Switzerland. The Swiss Academy of Medical Sciences (SAMS) provides the national licence for the Cochrane Library[13]. The Swiss Academy of Sciences (SCNAT) is highly committed to the creation of a Swiss Natural History Collection Network, which is dedicated to the digital preservation and reuse of natural science-collections in an open science perspective. Moreover, SCNAT sees its role in establishing an exchange between the funding and policy organizations and the scientific communities about their position towards open science[14]. Based on its Open Science Policy[15], the Swiss Academy of Humanities and Social Sciences (SAHS) is funding e-Infrastructures (dictionaries, editions, databases, collections, etc.) that aggregate and present sustainable data for research and for the broader public, whereas Metagrid and histHub ensure interoperability and data sharing[16]. Furthermore, the SAHS finances approximately 80 SSH-journals and series for them flip to Green or Diamond Open Access and it supports the retro-digitalisation of journals. Science et Cité – as the centre of competence for the dialogue between science and society of the Swiss Academies – is strongly engaged in the field of Citizen Science and has developed the Citizen Science Network Switzerland and the platform schweiz-forscht.ch / tous scientifiques.ch.

10 https://www.swissuniversities.ch/fileadmin/swissuniversities/Dokumente/Organisation/SUK-P/SUK_P-2/SUK_P-2_NationaleStrategie_20140403_EN.pdf
11 https://www.swissuniversities.ch/fr/organisation/projets-et-programmes/p-5/cosi/
12 Swiss Academies of Arts and Sciences (2019): Open Science in Switzerland: Opportunities and Challenges. Swiss Academies Factsheets 14 (2). https://doi.org/10.5281/zenodo.3248929; Swiss Academies of Arts and Sciences (2019): Open Access: Position of the Swiss Academies of Arts and Sciences. https://doi.org/10.5281/zenodo.2649115;
13 Cochrane Library (website SAMS): https://www.samw.ch/en/Projects/Access-to-scientific-literature.html.
14 Report «National significance of natural history collections in Switzerland": DOI: 10.5281/zenodo.1481727.
15 Open Science Policy of the Swiss Academy of Humanities and Social Sciences (2019). https://doi.org/10.5281/zenodo.2634242.
16 Website Metagrid: https://www.metagrid.ch/; Website histHub: https://histhub.ch/.

SWITCH perspective

SWITCH has long-term experience in the secure operation of (critical), national, digital infrastructures as a basic information infrastructure for open science in education, research and innovation in Switzerland. This includes our key competencies in Network, Security, Identity and Access Management and Infrastructure and Data Services.

Additionally, SWITCH has a unique track record in bringing together and empowering the people in the educational, research and innovation communities in Switzerland to create joint added value for sustainable solutions.

SWITCH is convinced that a joint realization of the Open Science Strategy of a FAIR Research Data ecosystem for Switzerland (Ref) offers unique opportunities to strengthen our prevalent national research and innovation capabilities by adding data quality management, discoverability, exploration and sustainable usage of linked and / or federated research data and their underlying infrastructures.

Moreover, the governance of SWITCH as an independent foundation, with a broad representation of the education, research and innovation communities, ensures not only joint decision-making but also a balanced involvement of heterogeneous and common interests.

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Annex D: Terminology

Here are the definitions on which the Strategy Document are based, some of which being defined by the expert group who realised this strategy, the other ones being selected from the diverse definitions available globally for those terms, focusing on the most appropriate in relation with the strategy.

Digital Infrastructures[17]**:** Digital infrastructures address the needs of researchers for digital services in terms of networking, computing, articles (for journals) and data management. Such digital infrastructures (sometimes also referred to as e-Infrastructures) foster the emergence of open science, i.e. new open working methods based on the shared use of ICT tools and resources across different disciplines and technology domains as well as the sharing of results

Open Science[18]: « Open science is about the way research is carried out, disseminated, deployed and transformed by digital tools, networks and media. It relies on the combined effects of technological development and cultural change towards collaboration and openness in research. Open science makes scientific processes more efficient, transparent and effective by offering new tools for scientific collaboration, experiments and analysis and by making scientific knowledge more easily accessible"

Open Data[19]**: "**Open data is the idea that some data should be freely available to everyone to use and republish as they wish, without restrictions from copyright, patents or other mechanisms of control"

Open Research Data: Open research data, and more generally research data definition, varies according to different disciplines, but mostly implies digital data which is collected, created and analysed with the purpose of producing original research results. Open research data, used as term in the context of open science, implies in similarity to open access, the open and free accessibility of research data, as well as to the necessary software to re-use and/or reproduce the findings. But taking legal and ethical restrictions into account, most funders such as the Swiss National Science Foundation understand open research data not as an unrestricted access to the material itself, but as an access which is as open as possible and as closed and protected as ethically and legally necessary.

Data Science: Data science is a multi-disciplinary field that uses scientific methods, processes, algorithms and systems to extract knowledge and insights from structured and unstructured data. Data science unifies statistics, data analysis, machine learning and their related methods in order to understand and analyse actual phenomena with data. It employs techniques and theories drawn from many fields within the context of mathematics, statistics, computer science, and information science

FAIR Data describes a set of principles in order to make research data operable for machines as humans. The principles of findability, accessibility, interoperability and reusability were set back in 2014 (Force 11 working group). These principles imply that the metadata of research data is openly available and readable, but does not imply that the data itself is accessible. Most funders such as the European Commission and the SNSF address research data management in this sense of the FAIR principles nowadays.

Citizen Science[20]: "It refers to a broad range of activities where people produce scientific knowledge outside of traditional scientific institutions. From mapping natural phenomena to analysing scientific data, sharing health information, and making new technologies, citizen science occurs across all the disciplines of science and involves a number of different methods of inquiry, both orthodox and alternative. It includes projects directed by scientists and by grassroots organisations as well as projects where power over the

17 Ref https://ec.europa.eu/digital-single-market/en/e-infrastructures
18 Ref https://ec.europa.eu/digital-single-market/en/open-science
19 Ref https://en.wikipedia.org/wiki/Open_data
20 Ref https://www.swir.ch/images/stories/pdf/de/Policy_Analysis_SSC_1_2018_Citizen_Science_WEB.pdf

design, implementation, and the use of outputs is shared among participants and organisers"

Open Innovation[21]: "A new paradigm where government, industry, academia and civil participants work together to co-create the future and drive structural changes far beyond the scope of what any one organisation or person could do alone"

Open Education[22]: "A way of carrying out education, often using digital technologies, aiming to broaden access and participation to everyone by removing barriers and making learning accessible, abundant, and customisable for all. It offers multiple ways of teaching and learning, building and sharing knowledge". The re-use, modification and redistribution of material is made possible by the appropriate use of open licences, such as those proposed by the Creative Commons organisation.

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Open Educational Resources (OER)[23]: "Teaching, learning and research materials in any medium, digital or otherwise, that reside in the public domain or have been released under an open licence that permits no-cost access, use, adaptation and redistribution by others with no or limited restrictions". OER come mainly in three forms:

a) as open online courses (massive or not)

b) as fully-fledged learning materials for learners (handbooks, manuals, encyclopaedias, didactic films, tutorials, etc) with an underlying open file format optimised for reading or viewing (e.g. PDF, EPUB)

c) as pedagogic materials for teachers (bibliographies, diagrams, maps, quizzes, questions for exams, annotated pictures, syllabi) with an underlying open file format optimised for editing and modifying (e.g. LaTeX source code, SVG), which can be combined and modified in order to produce fully-fledged learning materials.

21 Ref https://ec.europa.eu/digital-single-market/en/open-innovation-20
22 Ref https://ec.europa.eu/jrc/en/open-education
23 Ref https://en.unesco.org/themes/building-knowledge-societies/oer

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